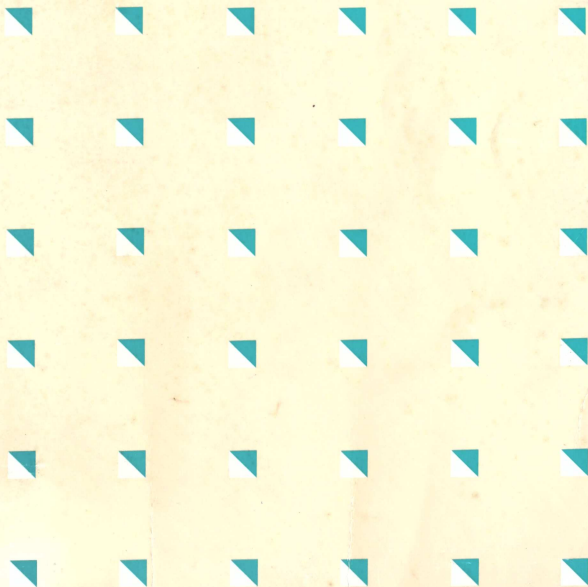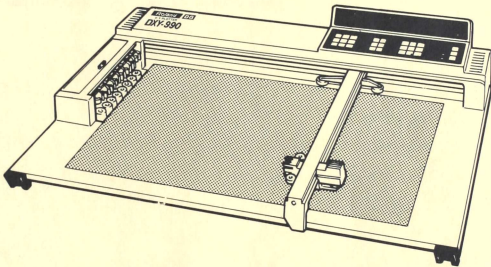# X-Y PLOTTER
DXY-990
OPERATION MANUAL

X-Y PLOTTER
DXY-990
OPERATION MANUAL

ROLAND DG CORPORATION

> Congratulations on your purchase of the ROLAND DG X-Y plotter [DXY-990].
> Please read and understand this manual well before using the DXY-990.

——TO THE USER——

• Do not place objects on the plotter and power cord as this may result in accidents or fires.

• Ensure that the power supply is within ± 10% of the rated voltage.

• Locate the plotter in an area with good ventilation and as free as possible from dust and humidity.

• Ensure that the plotter is not subjected to heavy shocks.

• If the panel becomes dirty, wipe it with a cloth dampened with water or neutral detergent. Do not use thinner or alcohol under any circumstances.

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1. Introduction

1.1 Outline and Features

The DXY-990 is the most sophisticated plotter among the DXY series. It is a professional plotter and provides the following features.

1) Newly developed switch panel makes it easier to change pens, pen speed, or to set positioning keys (eight directions), the P1 and P2 positions etc.
2) Easy and reliable paper setting by an electrostatic adsorption system.
3) A pen case to store the pens after use.
4) Equipped with a coordinate display on which the X and Y coordinate values can be seen at a glance.

Main Features of DXY-990.

1) Quality drawing with high speed.
   Thanks to the 0.05mm/step resolution, quality drawing can be assured with quiet drawing operation.
   At maximum plotting speed, (300mm/sec), the plotter will considerably shorten the plotting time, which no plotter among this class can beat.

2) Easy and reliable paper setting.
   Thanks to its electrostatic adsorption system, paper can be set quickly without sagging or riding.

3) An ink pen can be used with the soft landing device.
   The pen up/down function is equipped with a mechanical soft landing device, which enables the use of drafting ink pen (optional). The device also reduces plotting noise.

4) Automatic pen up function.
   If the pen is down and not in operation for a certain period, it will lift automatically to prevent smearing.

5) X-Y coordinate display.
   The X and Y coordinate values at the current pen position can be seen at a glance on the LED coordinate display. The position values are displayed in units of 0.1mm. This display enables easy manual setting of the precise positions of the scaling points P1 and P2, and program debugging.

6) RD-GL 1 command
   Systematically composed commands provide unrestricted drawing capability such as setting precise drawing conditions, scaling (enlargement/reduction), windowing, and user coordinates etc. Furthermore, the digitizing function enables the computer to store the current status of the plotter.
   Compatible with Hewlett Packard "HP-GL ™" of HP-7470/7475.

7) Automatic pen cap system.
   The pen is automatically capped when it returns to the pen clip to prevent it from drying out.
   If a drawing command is delayed while the plotter is in use, the pen automatically returns to the pen clip and is capped.

8) Automatic origin setting.
The DXY-990 is capable of automatically setting the original position even if the pen carriage is not in the original position when the power supply is turned on.
When the power source is supplied, the pen carriage moves to the right, goes up and after reaching the top, goes down. Then it moves to the left to set the original position of coordinate. Then it moves to the upper right position to set the paper for plotter.

9) Wide range of pen options.
The three basic pen sets have been developed for the DXY series; water-based pens (0.3mm/0.6mm), oil-based pens for over head projection transparencies (0.3mm/0.6mm), and water based ball-point pens.
Supplemented with two additional sets: ink pens and ceramic pens, a full range of pens is available to suit the user's purposes or on different types of the paper.

10) Compact, light vertical type.
The DXY-990 is compact: 608mm(W) × 452mm(D) × 115mm(H) and weighs 6.5kg.
In limited space, the built-in folding stand can be used to install the plotter vertically at 60 degrees.

11) The plotter is capable of enlarging or reducing a drawing easily. It is also capable of drawing only a specific part of a drawing. Further more, this particular part can be enlarged or reduced.

12) The plotter is capable of plotting slanted characters at various angles or rotating lines of characters.
Command can specify detailed drawing positions or size of characters (height and width).

13) Variety of character fonts.
19 kinds of character fonts are available including English, German, French, Spanish, Scandinavian, etc.

14) Equipped with two types of interfaces.
The plotter is equipped with a parallel interface (centronics) and a serial interface. (RS-232C)

15) Up-to-date panel switch.
The newly developed panel switch provides easy operation in changing pens, pen speed or setting positioning keys (eight directions), or the P1 and P2 positions.

16) Pencase
The plotter is equipped with a pen case capable of stowing away eight pens after use.

1.2 Initial Inspection For Accessories

Before using, please confirm that the following accessories are included in your plotter.
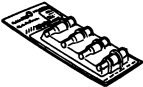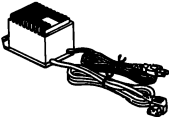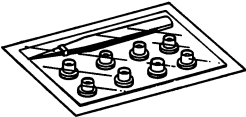
Accessory		Quantity
① Original pens 0.3mm Water-based fiber tipped pen	XD-4SPB-WN (black, blue, red, green) XD-4SPC-WN (orange, violet, brown, pink)	8
② Marking seal (Cropmarks sheet)		1
③ Rubber seal (Paper guide)		1
④ Original AC adaptor		1
⑤ Pen cap set for ink pens		1
⑥ Dust cover		1
⑦ Operation Manual		1
⑧ Before Using the DXY-990 Plotter		1
⑨ Reference Table		1

Table 1-1

1.3   Optional Accessories

Option	Model No.	Specifications
Original pen sets Water-based fiber-tipped pens	XD-4SPA-WN XD-4SPB-WN XD-4SPC-WN XD-4SPA-WW XD-4SPB-WW XD-4SPC-WW	0.3 mm dia (black) 4 pc set 0.3 mm dia (one each of black, blue, red and green) 4 pcs. assorted 0.3 mm dia (one each of orange, violet, brown and pink) 4 pcs assorted 0.6 mm dia (black) 4 pc set 0.6 mm dia (one each of black, blue, red and green) 4 pcs assorted 0.6 mm dia (one each of orange, violet, brown and pink) 4 pcs assorted
Oil based fiber tipped pens for OHP film	XD-4SPB-ON XD-4SPC-ON XD-4SPB-OW XD-4SPC-OW	0.3 mm dia (one each of black, blue, red and green) 4 pcs assorted 0.3 mm dia (one each of orange, violet, brown and yellow) 4 pcs assorted 0.6 mm dia (one each of black, blue, red and green) 4 pcs assorted 0.6 mm dia (one each of orange, violet, brown and yellow) 4 pcs assorted
water based ball-point pens	XD-4SPB-BP	(one each of black, blue, red and green) 4 pcs. set
Ink pen	ST-PH ST-P25 ST-P35 ST-P50 ST-INK KF-INK ST-P25F ST-P35F ST-P50F ST-INKF	Pen holder 0.2 mm dia pen tip ⎫ 0.3 mm dia pen tip ⎬ For regular paper only 0.5 mm dia pen tip ⎭ Special ink Ink that can be erased with an eraser 0.2 mm dia, pen tip ⎫ 0.3 mm dia, pen tip ⎬ For film only 0.5 mm dia, pen tip ⎭ Special ink
Ceramic pen	XD-4SPA-CN XD-4SPB-CN XD-4SPA-CM XD-4SPB-CM XD-4SPA-CW XD-4SPB-CW	0.2 mm dia (black) 4 pc. set 0.2 mm dia (one each of black, blue, red and green) 4 pcs. assorted 0.4 mm dia (black) 4 pc set 0.4 mm dia (one each of black, blue, red and green) 4 pcs. assorted 0.6 mm dia (black) 4 pc. set 0.6 mm dia. (one each of black, blue, red and green) 4 pcs. assorted
Overhead transparency kit	XY-TRK	50 transparent sheets OHP pens 0.3 mm 8-color set 0.6 mm 8-color set

Explanation of Pen Model No.	XD-4SPO—○○

W Water-based fiber-tipped pen ── ⎡ N   0.3mm
⎣ W   0.6mm

O OHP (Overhead projector) pen ── ⎡ N   0.3mm
⎣ W   0.6mm

C Ceramic pen ── ⎡ N   0.2mm
⎢ M   0.4mm
⎣ W   0.8mm

BP Water based ball point pen

A   Black
B   Black, blue, red and green assorted
C   Orange, violet, brown and pink assorted
(OHP pens only orange, violet, brown and yellow)

Table 1-2

Option	Model No.	Compatible models
Connecting cables : For parallel interface (Centronics)	XY-IPC	IBM PC (5150), PC XT (5160), PC AT (5170)
For serial interface (RS-232C) ''-	XY-RS-11 (1.5m) XY-RS-31 (3 m) XY-RS-13 (1.5m) XY-RS-33 (3 m) XY-RS-14 (1.5m) XY-RS-34 (3 m)	APPLE II, IIe '' IBM PC (5150), PC XT (5160) '' IBM-PC AT (5170) ''
Parallel interface card :	XY-APL	APPLE II, IIe (cable included)

* APPLE II, IIe are trademarks of Apple computer Inc.
• IBM PC, PC XT, PC AT (5170) are trademarks of International Business Machine Corporation.

Table 1-3

Data Buffer Unit

Option	Model No.	Specifications
Data Buffer	SYA-350	3.5in. Disk Drive Equipped Centronics(IN/OUT)and RS-232C (IN/OUT)Ports, Off Line Operating Capable, Repeat Operating Capable.

Table 1-4

1.4 Cautions

<Installation>

1) Install the plotter on a stable flat base or install it vertically (60 degrees), using the built-in stand.

2) When using a drafting ink pen, the plotter has to be installed horizontally to avoid improper ink flow.

3) Avoid places where the plotter may be exposed to direct sun light, high temperatures, dust, or high humidity.

4) Avoid places where the plotter may be exposed to high levels of vibration or noises.

5) As the power supply section (AC adaptor) generates heat during operation, the installation area has to be well ventilated to ensure cooling.

<During Operation>

1) Do not scratch or damage the electrostatic board (black section) as it may cause malfunctioning and can be dangerous since high voltage is supplied.

2) The power supply cord and input/output cables for the computer should be connected firmly to avoid disconnection or malfunctioning during operation.

3) When initially hooking up with a computer, execute the self-operation check (2.7 Operation Check in the Chapter 2) to insure that the plotter is operating normally.

4) When the power supply is turned on, the automatic origin setting operates and the arm and the pen carriage start to operate.
Keep them free from hands or objects.

5) Do not block the ventilation outlet or cover the AC adaptor with things.

<After using or when not using the plotter>

1) The automatic pen cap is designed to protect temporarily the pens from drying out.
If you do not use the plotter for a certain period, remove the pens from the pen clips and cap them and store.

2) In case not using the plotter, do not forget to unplug the power supply cord.

<Miscellaneous>

1) NEVER lubricate any of the mechanical parts.

2) To prevent scratching and damaging, do not place heavy objects on the drawing board.

3) Do not apply heavy loads or shock to the arm (Y-rail) or the pen carriage.

4) If the drawing board or X-rail cover get dirty, wipe them with a water dampened or neutral detergent dampened cloth.

5) Do not move the arm or the carriage manually after the power is on.

2. Preparations

2.1 Components

[External view]
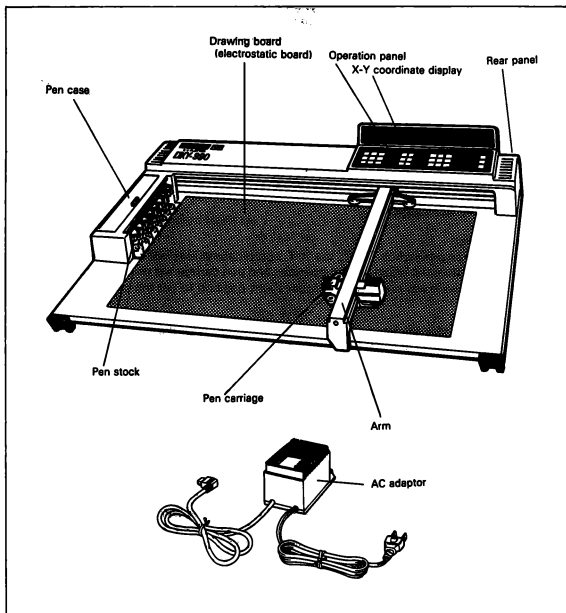
Fig. 2-1

[Rear Panel]
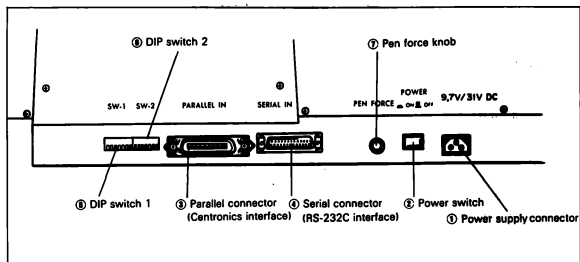
Fig. 2-2

① Power supply connector.
Connect the AC adaptor.

② Power switch
Setting the power switch "ON", the X-Y coordinate values will be displayed as "0.0"
Then, the automatic origin setting operates and pen carrige will move to the Lower Left
Position. Then it will move to the Upper Right position to set the paper for plotter.

③④ I/O connector
These connectors are used to connect the DXY-990 with the computer. Either the
parallel (centronics) or serial (RS-232C) interface connector may be used depending on
data specifications.

(Note) Both connectors cannot be used simultaneously.

⑤ SW-1 (DIP Switch 1)
The switch is used to select the .I/O connector (parallel or serial) set paper size,
character font etc.
For details, refer to "8.4 Dip Switch Setting Table" in Chapter 8.

⑥ SW-2 (DIP Switch 2)
The switch is used to set the data format and baud rate when the serial interface in
used.
For details, refer to "8.4 Dip Switch Setting Table" in Chapter 8.

⑦ Pen Force knob
The knob is used to adjust slightly the pressure applied to the pen tip in the down posi-
tion.
For details, refer to "3.2.2 Writing Pressure of Pens" in Chapter 3.

[Operation Panel]
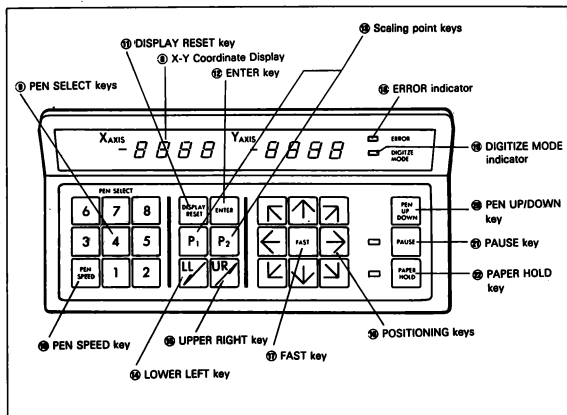
Fig. 2-3

Ⓑ X-Y Coordinate Display
Displays the position of the pen carriage in X-Y coordinate values.
For details, refer to "2.2.2 X-Y Coordinate Display" in this Chapter.

Ⓓ PEN SELECT Keys
The pen can be selected either by the operation panel or command; however the last designation has priority in pen selection.
Pen speed can be set in combination with using PEN SPEED Ⓔ Key.
Pressing ENTER Ⓙ key together with PEN SELECT Ⓓ key returns the pen in the pen carriage to the designated pen stock. But if an occupied pen stock is designated, the pen in the pen carriage will hit it and a malfunction will occur.
In this case, reset the plotter by pressing ENTER Ⓙ key together with LOWER LEFT Ⓚ key.

Ⓔ PEN SPEED Key
When setting the pen speed by the operation panel, PEN SELECT Ⓓ key also has to be used.
For details, refer to "3.2.1 Drafting Speed" in Chapter 3.

2 - 3

⑪ DISPLAY RESET key
Pressing this key causes the X-Y coordinate display to show "0.0" for both X and Y values at the current position.
From then on, the coordinate values shown on the display are based on the new origin "0.0" which is set when this switch is pressed. For details, refer to "2.2.2 X-Y coodinate display" in this Chapter.

⑫ ENTER key
Pressing this key together with P1 or P2 ⑬ key sets the scaling point of P1 and P2. This key is also used to digitize points on the drawing board.
For details, refer to "5.6 Digitizing" in Chapter 5.
Turning ON the power supply while pressing this key sets the self-test mode.
For details, refer to "2.7 Operation Check" in this chapter. This key can also be used in conjunction with other keys.

⑬ Scaling point keys "P1" and "P2"
Pressing P1 or P2 key causes the pen to lift and more to the scaling point P1 or P2. When manually setting the scaling point, ENTER ⑫ key has to be used in conjunction with these keys. For details, refer to "2.2.3 Setting of P1 and P2" in this chapter.

⑭ LOWER LEFT key
Pressing this key causes the pen to return to the pen clip and the pen carriage moves to the lower left position on the drawing board and command errors are cleared. RS-232c error are not cleared.
Pressing this key together with ENTER ⑫key, resets the plotter just as if the power supply were turned on.

⑮ UPPER RIGHT key
Pressing this key causes the pen to return to the pen clip and the pen carriage moves to the upper right position on the drawing board.
This key can also be used to change paper.
When drawing is stopped temporarily by PAUSE ㉑ key, pressing this key together with ENTER ⑫ key clears the data buffer. This key can also be used to re-draw from the beginning after troubleshooting.

⑯ POSITIONING Keys
These keys are used to move the pen manually in any of the eight directions indicated on the keys.

⑰ FAST Key
Pressing this key together with a POSITIONING ⑯ key increases the pen speed.
Also pressing this key together with ENTER ⑫ key causes the X and Y coordinate to rotate 90 degrees. For details, refer to " RO Command" in Chapter 6.

⑱ ERROR Indicator
If an error occurs, the indicator will blink.

⑲ DIGITIZING MODE Indicator
When the computer sends a digitizing command, the plotter enters the digitizing mode and the indicator goes on.
When the digitizing mode is completed, the indicator goes off and returns to the normal mode.
For details, refer to "5.6 Digitizing" in Chapter 5.

⊛ PEN UP/DOWN key
· · When the plotter is at standby (including when the plotter is not operated programably
by computer or is in a Test Mode), pressing this key causes the pen to go down.
But if the pen is kept in this condition for a certain period, the automatic pen-up system
operates and the pen lifts. In this case, pressing the POSITIONING ⑩ key causes the
pen to go down to operate.

⑪ PAUSE key
When this key is pressed during program excution, PAUSE LED gose on and plotting
Operation is temporarily halted. And the plotter start to operate again, PAUSE LED goes
off when this key is pressed again.

⑫ PAPER HOLD Key
Pressing this key causes the paper to stick to the drawing board by electrostatic
paperholder.
For details, refer to "2.6 Paper setting" in this Chapter.

2.2 Functions

2.2.1 Automatic Penup System

If no command is input for about three seconds while the pen is down, the pen
automatically lifts to prevent ink smearing.
Pressing a POSITIONING ⑩ key clears the automatic penup function, and drawing
begins.

2.2.2 X-Y Coordinate Display

The position of the pen carriage is displayed as the X-Y coordinate values. The coor-
dinates are displayed in 1 mm units. Decimal fractions are rounded up or down. When
DISPLAY RESET ⑪ key is pressed, the current pen position is set at (0.0)
To move the display origin back to the lower left corner, press LOWER LEFT ⑭ key to
move the pen carriage to the lower left position, press POSITIONING ⑩ key ⎡ ↓ ⎤ to
move the pen carriage to the origin. Then DISPLAY RESET ⑪ key again.

2.2.3 Setting P1 and P2

Pressing either P1 or P2 key together with ENTER ⑫ key sets the current pen carriage
position as the scaling point P1 and P2.
Pressing either P1 or P2 key causes the pen carriage to move to the P1 and P2 positions
to confirm.

2.3   Installation

The DXY-990 may be mounted either or vertically (60°) with the aid of the built-in stand.

2.3.1   When Used Horizontally.
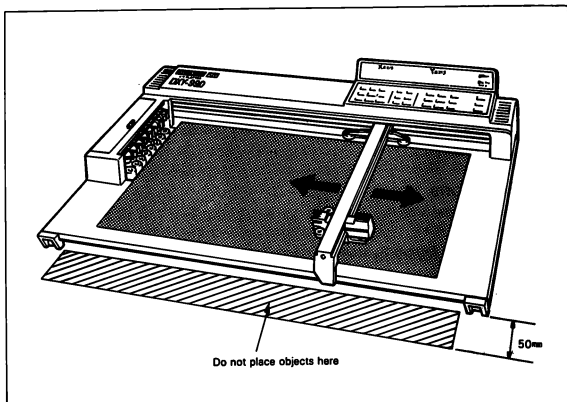
Fig. 2-4

1) Install on a flat stable base.
2) Keep the shaded area in Fig.2-4 free from objects that the arm is able to move freely.
3) When using the ink pens, use the plotter in a position.

2.3.2 When Used Vertically.
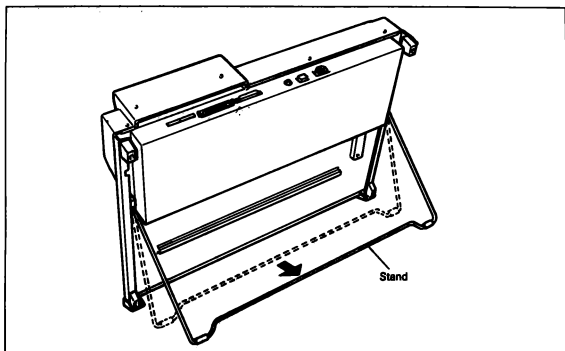
Fig. 2-5
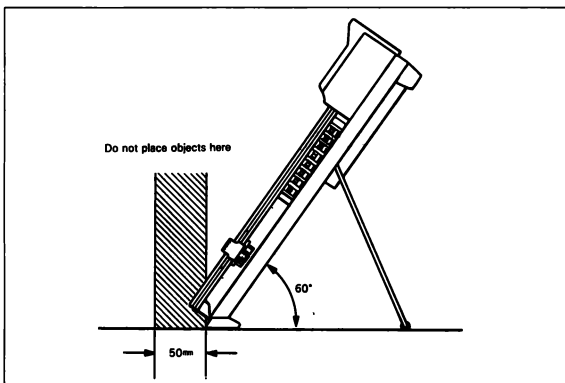
Fig. 2-6

1) When the stand is pulled in the direction of the arrow as shown in Fig 2-5, it will be fixed automatically.
2) To fold the stand flat, push both ends gently in towards the center and then lay the stand against the back of the drawing board.
3) Keep the shaded area in Fig.2-6 free from object to ensure that the arm is able to move freely.
4) The plotter should always be installed on a flat stable base.
5) Do not apply heavy loads to the plotter surface or the stand.

2.4 Connecting the Power Supply (AC adaptor)

1) Make sure that plotter power supply is OFF.
   Plug the AC adaptor cord into the power supply connector of the plotter.
2) Insert the AC adaptor plug into the wall outlet.
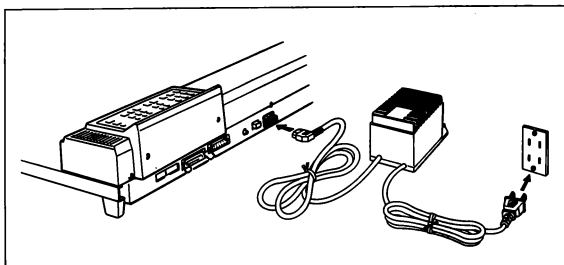
Fig.2-7

.Note: If you finish using the plotter, turn the power switch OFF first and then unplug the cord.

2.5   Fitting Pens

Fit a pen into the pen stock at the left side of the plotter without attaching the pen to the pen carriage. The numbers 1 to 8 of the pen clips correspond to the parameters 1 to 8 of the Pen Change Command so that any color pen can be assigned to any pen stock. In addition to accessory water-based fiber-tipped pens, water-based ball-point pens, oil-based OHP pens, ink pens (for paper and for film) are available as options.

2.5.1   How to Fit Pens
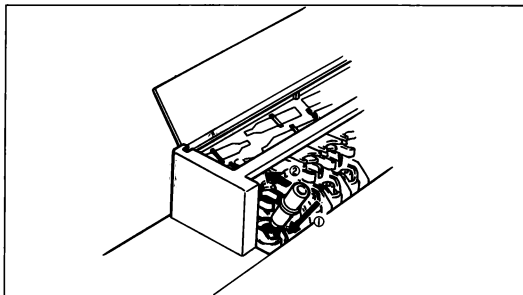
Fig. 2-8

Remove the cap first. Attach a pen at the pen stock, inserting the ring into the pen stock, while pressing the pen cap with the pen tip as shown in Fig. 2-8.

To remove a pen from the pen stock, do the opposite of what you do to fit a pen, and cap it.
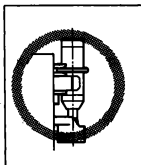
Proper fitting   Improper fitting
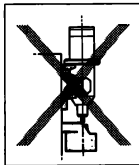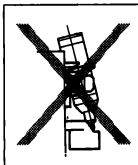
Drafting can not be performed properly

Fig. 2-9

2.5.2 Changing Pencaps

Black pen caps at the time of shipping are attached at the pen stock to be used for the water-based fiber-tipped pens and ceramic pens.

Since the black pen caps cannot fit the ink pens, use the white rubber caps for the ink pens to prevent them from drying out. Also, as an ink pen rubber cap can not fit the other pens, pen caps should be changed according to the pentype, refering to the pen number.

(If an ink pen rubber cap is attached at the pen stock and another type of pen (other than the ink pen) is attached at the penstock, the cap cannot fit the peh and may dry out.)
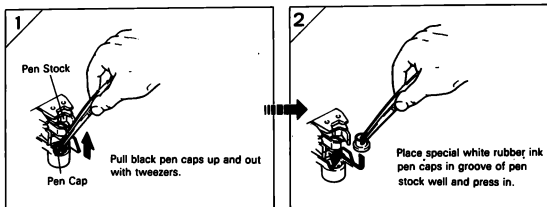
Fig. 2-10

Note:

1) The pens should be set correctly to prevent troubles.

2) Be careful not to damage the pencaps with the tips of tweezer in handling them as they are made of rubber.

3) Try to match the pen number and the pen color, or the colors may get mixed up. Clean the inside of the cap with a wet swab when changing color.

4) Do not turn the power of the plotter on while a pen is in the pen carriage. The plotter starts operating on the understanding that no pen is in the pen carriage.
   As a result, two pens may hit and be damaged.
   This may distort the coordinate and proper drafting or pen changing will be affected.

5) Do not lose the pen caps
   The pen caps attached at the pen stock are designed to protect the pens from drying out temporarily. If you do not use the plotter for a prolonged time remove the pens from the penstock, replace pen caps, on and store.

2.6 Paper setting

Up to A3 size (420mm × 297mm) or B size (432mm × 279mm) paper can be used as the media for the plotter. Paper setting is as follows:

1) First confirm that the power supply connector is connected to the AC outlet through the AC adaptor.
   Then, turn the power switch ON.
2) Confirm that the paper hold switch is OFF.
   (PAPER HOLD LED OFF)
3) Set the paper according to the size shown in Fig. 2-11.
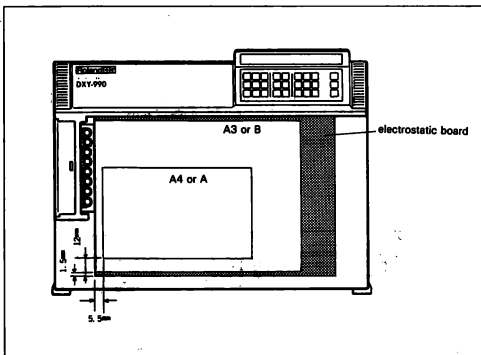
Fig. 2-11

4) Turn the paper hold switch ON. (PAPER HOLD LED ON)
   The paper will be fixed in place on the drafting board.
5) Remove riding or sagging of the paper with cloth if any, as shown in Fig. 2-14. The paper setting is now completed.
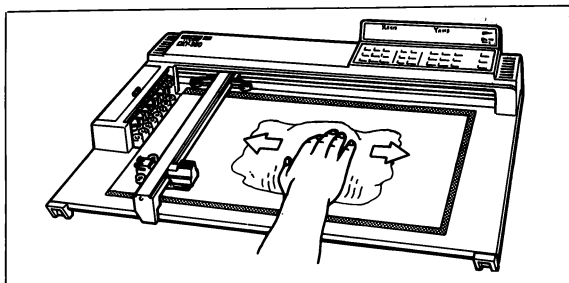
Fig. 2-12

When removing the paper from the drafting board, turn the PARPER HOLD key OFF. In this case the adsorption force will remain for a short time.

When using the same size of paper, it is efficient to apply an accompanied rubber or marking seal.

Marking seal
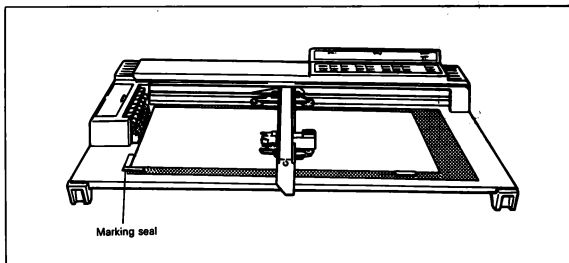
Fig. 2-13

Note: To prevent scratching and damaging, do not use pointed objects such as compasses, cutters or pins on the board.

Reference
The electrostatic paper setting method uses the generation of static electricity to hold the paper. A fairly high voltage is applied inside the electrostatic board, however this will not affect a human body if touched, since the electric power is very low and the voltage quickly drops. Also, the electrostatic board is resin coated, and it can not be touched directly unless it is damaged or scratched by pointed objects.

Note: Only one sheet of paper can be affixed at a time.
For example, when drawing or transparent film such as OHP film, using a
white paper beneath the film makes it much easier to see, but the film will
not be fixed by an electrostatic paper holder

2.7 Operation Check (Self-test Mode)

Check the plotter to see if it works properly before hooking it up to a comprter.
Set the pens at all the pen clips.
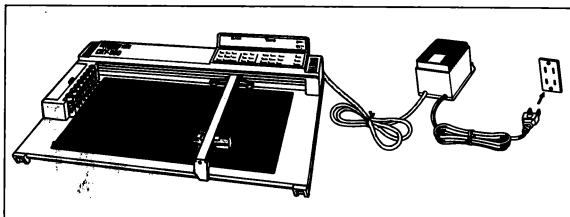
Fig. 2-14

1) Confirm that the power switch of DXY-990 is OFF.
2) Turn the power switch ON while pressing ENTER key.
3) The Automatic Origin Setting operates, and enters the pause state when the pen
   carriage reaches the upper right position. (PAUSE LED ON)

4) Set an A3 paper on the plotting board and turn the paper hold switch ON. (PAPER
   HOLD LED ON)

5) Clear the pause state by pressing PAUSE key. (PAUSE LED OFF)

6) The plotter starts to operate to draw as shown in the Fig. 2-15.
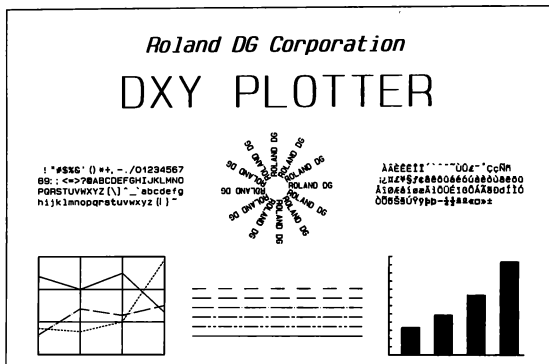
Fig. 2-15

7) When self-test drawing is finished, the plotter backs to the normal mode.

Note:
    1) Do not move the arm or the pen carriage manually when the power switch is ON.
    2) During the self-test mode, the plotter can not be operated manually or by the computer.

3. Pens for Plotter

3.1 Wide Range of Pens and Characteristics

Water-based fiber-tipped pens , ceramic pens , water based ball-point pens , oil-based
OHP pens and ink pens are available as options for the DXY-990 .
Select the most suitable pens to meet your purposes or on different types of paper ,
refering to the following descriptions .

Note 1   Water-based fiber-tipped pens, ceramic pens, water-based ball-point
pens, and oil-based OHP pens are not rechargeable.
As for the ink pens, there are three kinds including ink for paper, for film
and for water-based erasable ink. Select the most suitable ink to meet
your needs.

Note 2   The DXY-990 is equipped with an automatic pencap system to prevent
the pens from drying out during operation.
If you don't use the plotter for a prolonged period, remove the pens from
the penstock, cap them, and store.
Take care that an inkpen tip does not dry out and get hard.

3.1.1 Water-based Fiber-tipped Pens

This pen is both easy to use and easy to handle , and provides a smooth ink flow ,
which is suitable for high speed drawing . Since colors come out well , the pen is
suitable for drawings , illustrations , or graphics .
The pen is able to draw up to 300mm／sec . However , using for a prolonged time
causes the pen tip to wear out and the lines to get wider . The pen is available in eight
colors with two Types of thickness , 0 .3mm and 0 .6 mm

XD-4SPA-WN	0 .3mm	A set of 4 blacks
XD-4SPB-WN	0 .3mm	black , red , blue , green
XD-4SPC-WN	0 .3mm	brown , purple , pink , orange
XD-4SPA-WW	0 .6mm	A set of 4 blacks
XD-4SPB-WW	0 .6mm	black , red , blue , green
XD-4SPC-WW	0 .6mm	brown , purple , pink , orange

Table 3-1

3.1.2 Ceramic Pens

The pen tip is protected with ceramics and a precise line width is kept from initial use
until the ink runs out .
The pens are available in   three kinds of widths; 0 .2mm , 0 .4mm and 0 .6mm .
These pens are suitable for drafting . Ink is water-based . The tip is very delicate ,
especially a 0 .2mm pen , so be careful not to drop it or strike it against something .
A proper pen speed is 150mm／sec .
The pen is available in four colors; black, red, blue and green.

XD-4SPA-CN	0 .2mm	A set of 4 blacks
XD-4SPB-CN	0 .2mm	black , red , blue , green
XD-4SPA-CM	0 .4mm	A set of 4 blacks
XD-4SPB-CM	0 .4mm	black , red , blue , green
XD-4SPA-CW	0 .6mm	A set of 4 blacks
XD-4SPB-CW	0 .6mm	black , red , blue , green

Table 3-2

3.1.3 Water-based Ball-point Pens

This pen provides a very fine and high speed drawing .
Since the pen tip is quite solid , it is easy to handle: but be careful not to drop or use on hard or coarse objects .
An extremely slow pen speed may cause an improper ink flow .
The maximum pen speed is 300mm/sec .

XD-4SPB-BP   black, red, blue, green

3.1.4 Oil-based OHP Pens

This is a fiber-tipped pen used for drawing on overhead projector film (OHP film)
There are many kinds of OHP film , so choose the one that matches the pen to avoid line bluring , color mixing , or improper filling .

We recommand our OHP film for the plotter as an option . The OHP film comes in eight colors: black , red , blue , green , brown , yellow orange and purple , and in two types; 0 .3mm and 0 .6mm . The 0 .6mm pen is suitable for filling . A proper pen speed is within 100mm/sec .

XD-4SPB-ON	0.3mm	black, red, blue, green
XD-4SPC-ON	0.3mm	brown, yellow, orange, purple
XD-4SPB-OW	0.6mm	black, red, blue, green
XD-4SPC-OW	0.6mm	brown, yellow, orange, purple

Table 3-3

3.1.5 Ink Pens

The following inkpens are available as options for the DXY-990 .
You can use these jointing an inkpen holder and an inkpen tip.

ST-PH	Inkpen holder (Short size)
ST-P25	Inkpentip for paper use 0 .2mm
ST-P35	Inkpentip for paper use 0 .3mm
ST-P50	Inkpentip for paper use 0 .5mm
ST-P25F	Inkpentip for film use 0 .2mm
ST-P35F	Inkpentip for film use 0 .3mm
ST-P50F	Inkpentip for film use 0 .5mm
ST-INK	Ink for paper use
ST-INKF	Ink for film use
KF-INK	Ink that can be erased with an eraser

Table 3-4

Ink pens are suitable for drawings and illustrations that require high picture quality, with the sharp and clear lines without changing line width or density. Since the pen structure is very delicate, sufficient knowledge and care are required in handling and maintenance. To optimise the inkpens, read this section carefully. An appropriate pen speed is within 150mm/sec.

Note:

1) When drawing on fine paper or tracing paper, use the ink and ink tip for paper use. (ST-P25, P35, P50, ST-INK)
   When drawing on drafting film, use the ink and ink tip for film use.(ST-P25F, P35F, P50F, ST-INKF)
   Choose ink and ink tip to suit different types of paper to obtain quality drawings and to avoid damaging the pentips.

2) Use the specifically developed ink for the plotter's use; ST-INK, ST-INKF, and KF-INK, that is different from ordinary ink (for writing). Do not use ordinary ink since it may cause blocking.

3) The pentip should be handled with care. Avoid any strong shock, such as shaking or dropping.

4) Avoid places where there are big temperature changes because this may cause leaking.

5) Do not disassemble the pentip.

6) Too high speed drawing may cause poor drawing quality.
   To obtain quality drawings, press PEN SELECT Key [4] or [5] while pressing PEN SPEED Key. Or set the drawing speed less than 150mm/sec by VS command. For details, refer to "3.2 Drafting Speed and Writing Pressure of Pens" in this chapter.

7) It is recommended that the DXY-990 be installed horizontally for drawing since a tilted inktank may cause improper ink flow.
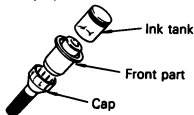
Fig.3-1   Fig.3-2

(1) Assembly and Ink Supply.

a) Take an inktip from the plastic case and screw it into the front part. Use the hexagonal hole portion of the plastic case to fix the pentip firmly.
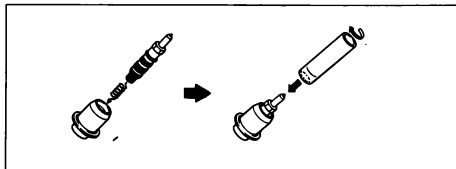
Fig. 3-3

3 - 3

b) Fill the ink tank with ink
Do not fill the tank above the line or ink will over flow when attaching the front part.
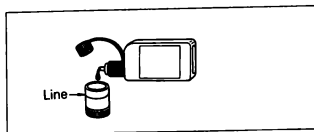
Fig. 3-4

c) Slowly push the front part into the ink tank.
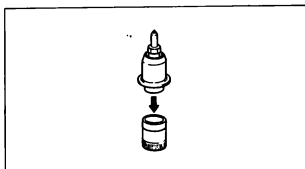
Fig. 3-5

d) Point the pentip downward and shake it up and down slowly.
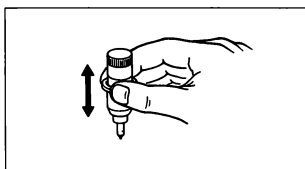
Fig. 3-6

Now the pen preparation has been completed.
Before setting the inkpen in the pen clip, check the pen on a piece of paper to see if the ink flows.

(2) Ink Supply

Refill the ink before it runs out, because when the ink level decreases, the air in the tank will expand, and this may cause ink leakage.

a) Remove the pen from the penclip.
b) Remove the front part slowly from the ink tank.
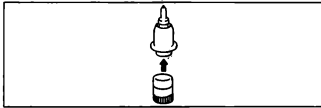
Fig. 3-7

c) Since the ink remains in the front part, tap it slightly on a piece of tissue paper to remove it.
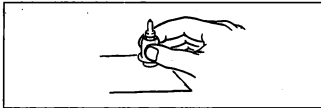
Fig. 3-8

d) Fill the inktank with ink.
   Do not fill the tank above the line since ink will overflow when attaching the front part.
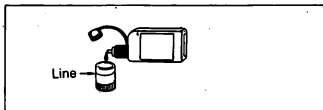
Fig. 3-9

e) Slowly push the front part into the inktank.
If the front part is pushed in forcefully, the internal pressure of the front part will change rapidly and this may cause ink leakage from the site of the pentip.
Should this happen, wipe up the ink with tissue paper or remove the pentip from the front part to wipe up the ink. In this case, wipe up the ink inside the front part.
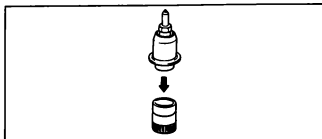
Fig. 3-10

(3) Maintenance of the Inkpen
    a) When immediate drawing is desired.
       Drawing can be started at the present conditions.
       Test the pen before drawing.
    b) When delayed drawing (3 to 4 hours) is desired.
       Remove the inkpen from the pen carriage, cap the pen and place it with the pentip upward. (It can be placed in the penstock). When starting drawing again, shake the pen slowly and it will be ready for drawing.
    c) If you do not use the pen for a prolonged time.
       To prevent blocking, remove the pentip from the front part and wash it.

(4) Washing Method
The washing method differs depending on the kind of ink used.
The following applies to when our ink is used.
(Take note that some inks other than our products can not be water washed.)
    a) Opposite to the assembling method, remove the pentip from the front part.
    b) Remove the ink remaining in the inktank.
    c) Wash the pentip, the front part and the inktank in the flowing water by shaking them. Washing is finished when the ink stops flowing. Remove the water and store.

    Note: Do not take the pentip apart as it is very difficult to reassemble.

(5) Should the Inkpen Get Blocked
Do not shake the inkpen unreasonably to move the inside needle. The needle is made of ultra-fine wire and shaking may break it. To move the needle easily, soak the ink pen in a cleaner[*] for one or two days.
Then follow the washing method mentioned before.

    * If pen cleaner is required, purchase the following products at a stationery store, or a drawing supplies store.

Manufacturer	: STAEDTLER
Product name	: Mar water based ink pen cleaner
Model number	: 100CC-74600 250CC-74625

(6) Causes and Measures for Ink Blockage

Ink blockage can be roughly classified into three as below.

Cause	Measure
The ink has been left inside the pen for a long time.	Refer to "Maintenance of the Ink Pen" and follow the appropriate procedure.
Dust or fiber from the writing surface has gathered at the pen tip during drawing	There is a tendency for the drawing line to become scratchy In this case, stop the plotter. refer to "Washing Method" and clean
The ink used does not suit the pen.	Use the special ink (ST-INK, KF-INK)

Table 3-5

3.2 Drafting Speed and Writing Pressure of Pens

3.2.1 Drafting Speed

The DXY-885 is capable of drawing at maximum speed of 300mm/sec. and this speed is selected at power on. In high-speed drafting lnke this, a line may become thin and proper drafting can not be guaranteed, due to improper combination of a pen and paper.
The DXY-990 pen speed can be freely adjusted depending on the type of pen and paper to be used. The following shows two examples.

(1) penspeed adjustment with control panel.

Press either of the PEN SELECT Keys (1) to (8) while the ENTER Key on the control panel is being pressed to change the pen speed. The pen speed set by each PEN SELECT Key is as follows.

Pen No.	1	2	3	4	5	6	7	8
Pen speed (mm/sec)	30	40	60	90	120	160	220	300

Table 3-6

Note: With the control panel, the pen speed can be selected only within the values set by the Pen Speed Setting command (VS).

This approach, which has nothing to do with the software, is extremely convenient when the software can not be changed by the user. It is possible to change the pen speed while plotting pictures, by pressing the PAUSE Key to stop plotting temporarily and to change the pen speed. Use this approach especially when there is only a small amount of ink left in the pen and the drafting becomes thin.

(2) Pen speed adjustment with programming

Use the pen speed command "VS" to change pen speed by programming. The pen speed can be varied from 10mm/sec to 300mm/sec.

[Example 1]   Setting pen speed to 150mm/sec
              LPRINT "VS15;"

Note: The unit of the pen speed after "VS" command is cm/sec

3.2.2   Writing Pressure of Pens

The DXY-990 Uses a Soft Landing system to allow the landing speed and the writing pressure of ink pens to be controlled for enhanced clarity and precision of line.
The optimum writing pressure of ink pens depends on such conditions as the angle of DXY-990 installation, pen speed, type and weight of pen , amount of ink, type of paper, ambient temperature and humidity. The writing pressure should be set as low as possible. Too much pressure wastes ink, wears pen tips, and may tear the paper.

(1) How to adjust writing pressure with PEN FORCE knob

Use the PEN FORCE knob on the rear panel to finely adjust the writing pressure. Turn the knob clockwise to increase the pressure and counterclockwise to decrease it.
The optimum writing pressure is the minimum pressure where the writing will not become thin Readjust the writing pressure every time the installation environment and drafting conditions change.

3.3   Automatic Pen Cap Function

In the DXY-990, pen caps are provided at the pen stocks when the drafting is terminated, the pen currently in use returns to the pen stock and is automatically capped to prevent the pen tip from drying.

CAUTION   Don't leave your hands or any objects on the drafting bord even if the pen is not
           moving when the power is on.
Note   Automatic pen cap function is a temporary measure for preventing the pens
           from drying.
           Don't forget to remove the pens and to cap them, when the plotter is not to be
           used for a long time, otherwise the ink at the ink pen tip may become hard.

3.4   Automatic Pen Up Function

The DXY-990 is provided with an automatic pen up function to prevent ink blotting on the paper if a pen remains at the down position for a long time.

4. Connections

4.1 Connection with Primary Personal Computers.
4.1.1 IBM PC (5150), PC XT (5160), PC AT (5170)

(1) Parallel connection

An interface card is required. Use the IBM parallel printer adaptor, IBM monochrome display and parallel printer adaptor or IBM PC AT Serial/Parallel Adapter.
See the operating manual of the interface card for details of instation.

Connecting Cable: Use the IBM printer cable or Roland DG XY-IPC.

Make sure that the DXY-990 power is OFF and then set DIP switch 1 as shown in Fig.4-1.
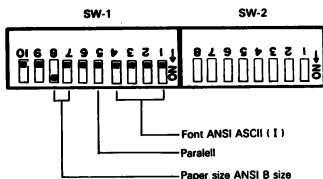
Fig.4-1

Connect the printer cable to the PARALLEL IN on the side panel of DXY-990

(2) Serial connection

An interface card is required. Use the IBM asynchronous communications adaptor, or IBM PC AT Serial/Parallel Adapter.

See the operating manual of the interface card for details of insallation etc..

Connecting cable: Use the Roland DG XY-RS-13, XY-RS-33 (PC,PC/XT),XY-RS-14, XY-RS-34 (PC AT).

Make sure that the DXY-990 power is OFF and then set DIP switch 1 and 2 as follows.
(The following example shows the case of connection at 1200 baud, Even Parity, stop bit 1, Data bits 7.)

SW-1 SW-2

Baud rate 1200 baud
Direct Connection
Parity Enable
Even Parity
7 data bits
1 stop bit

Font ANSI ASCII(I)
Serial Connection
Paper size ANSI B
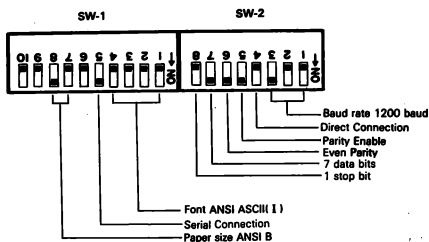
Fig.4-2

Connect the Roland DG XY-RS-13 or XY-RS-33 Cable to the SERIAL IN on the rear panel of DXY-990.
The internal wiring connections of the Roland DG XY-RS-13, XY-RS-33, XY-RS-14, XY-RS-34. cable are as shown below.

XY-RS-13, XY-RS-33 CABLE

IBM PC or PC/XT			PLOTTER	
	Pin No.		Pin No.	
F.G	(1)	————————	(1)	F.G
TXD	(2)		(2)	TXD
RXD	(3)		(3)	RXD
RTS	(4)		(4)	RTS
CTS	(5)		(5)	CTS
DSR	(6)		(6)	DSR
S.G	(7)		(7)	S.G
DCD	(8)		(8)	DCD
DTR	(20)		(20)	DTR

XY-RS-14, XY-RS-34 CABLE

IBM-PC/AT			PLOTTER	
	Pin No.		Pin No.	
DCD	(1)		(1)	F.G
RXD	✓ (2)		(2)	TXD
TXD	✓ (3)		(3)	RXD
DTR	✓ (4)		(4)	RTS
S.G	(5)		(5)	CTS
DSR	✓ (6)		(6)	DSR
RTS	(7)		(7)	S.G
CTS	(8)		(8)	DCD
Ring Indicator	(9)		(20)	DTR
DSUB-9 pin			DSUB-25 pin	
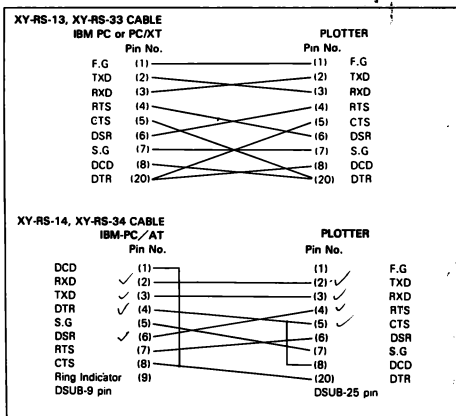
Fig.4-3

4.1.2 APPLE II, IIe

(1) Parallel Connection
An interface card is required. Use the Roland DG XY-APL card.
See the manual supplied with the XY-APL for details of installation etc.

Set the switch on the XY-APL as shown below.
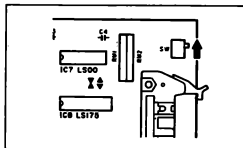
Fig. 4-4

Make sure that DXY-990 power is OFF and then set DIP switch 1, 2 as shown below.
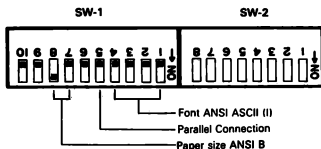
Fig.4-5

Connect the cable from the Roland DG XY-APL to the PARALLEL IN on the side panel of DXY-990

This completes connection. See the Roland DG XY-APL manual for details of the inter-face card. Use the cable supplied with the Roland DG XY-APL.

Note:
If a parallel printer card and cable other than the XY-APL is used the DXY-990 will not operate unless bit 7 (MSB) is set to LOW or modified.

(2) Serial Connection
An interface card required. Use the APPLE II Super Serial Card.

The following example shows the case of connection at 1200 baud, even parity, stop bit 2, and data bit 7.

Set DIP switches 1 and 2 on the Super Serial Card as shown in Fig. 4-6.

Set the jumper block so that the triangle is as shown in Fig. 4-6.
(ie. set to the communication mode.)
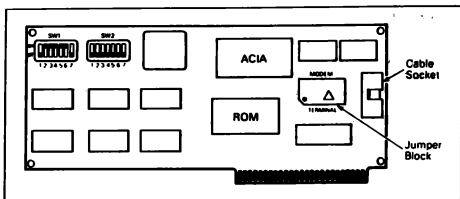
Fig.4-6

Switch the APPLE power OFF, remove the top cover and plug the Super Serial Card into slot #2. the Super Serial Card manual for details.

Connect the Roland DG XY-RS-11 or XY-RS-31 cable to the 25-pin connctor on the Super Serial Card.

Make sure that the DXY-990 power is OFF and then set DIP switches 1 and 2 as shown below.
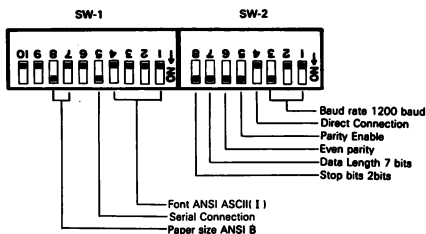
Fig.4-7

Connect the Roland DG XY-RS-13 cable to the SERIAL IN on the side panel of DXY-990.

This completes connection. See the Super Serial Card manual for details of baud rate and parity checking.
The internal wiring connections of the Roland DG XY-RS-11 or XY-RS-31 cable are as shown below.

```
          APPLE II, IIe              ʌ,            PLOTTER
             Pin No.                             Pin No.
      F.G    (1) ──────────────────────── (1)    F.G
      TXD    (2) ──────┐      ┌────────── (2)    TXD
      RXD    (3) ─────┐└──────┘┌────────  (3)    RXD
      RTS    (4) ─────┐└───┐  ┌┘┌───────  (4)    RTS
      CTS    (5) ────┐└┐   └──┘┌┘┌──────  (5)    CTS
      DSR    (6) ───┐└┐└──────┐└┐└──────  (6)    DSR
      S.G    (7) ───┘ └───────┘ └──────── (7)    S.G
      DCD    (8) ──┐      ┌───────────── (8)    DCD
      DTR   (20) ──┘      └───────────── (20)   DTR
```
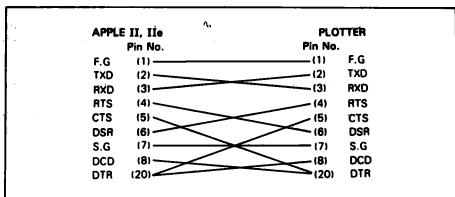
Fig.4-8

4.2 Commands from the Computer

4.2.1 IBM PC (5150), PC XT (5160), PC AT (5170)

When DOS is strated up, execute the following program, and it can protect becoming DEVICE TIME OUT. However, MODE COM is required for System Disk.

```
On Parallel connection    :A>MODE LPT1:,,P
On serial connection      :A>MODE COM1:12,,,,P
```

(1) Parallel connection

```
10  REM *** SAMPLE FOR IBM-PC ***
20  REM      by Pallel
30  LPRINT"PU;PA0,0;"
40  LPRINT"SP1;PD3600,0,3600,2700,0,2700,0,0;"
50  LPRINT"SP;"
60  END
```

(2) Serial connection

```
10  REM *** SAMPLE FOR IBM-PC ***
20  REM      by Serial
30  OPEN "COM1:1200,E,7,1,CS65535"AS #1
40  PRINT#1,"PU;PA0,0;"
50  PRINT#1,"SP1;PD3600,0,3600,2700,0,2700,0,0;"
60  PRINT#1,"SP;"
70  CLOSE
80  END
```

4.2.2 APPLE II, IIe

The same commands are sent from the APPLE II, IIe to the DXY-990 with serial and parallel connection.

Example: Plotting a rectangle

```
10  REM *** SAMPLE ***
20  PR#2
30  PRINT "PU;PA 0,0;"
40  PRINT "SP1;PD3600,0,3600,2700,0,2700,0,0;"
50  PRINT "SP;"
60  PR#0
```

Note:
* With both serial and parallel connection, if PR#0 is not executed at the end of the program, all the input from the keyboard will be sent to the DXY-990 at the end of the program.

* With serial connection, the following cautions are required when output from the plotter is received with the APPLE II.
  IN#2 and PR#0 must be executed, output from the plotter cannot be recived, and if PR#0 is not executed excess codes are sent to the plotter when output is received and an error occurs.

```
10   REM *** SAMPLE ***
20   PR#2:IN#2
30   PRINT CHR$(27);"E";
40   PR#0:INPUT E
50   PR#2
60   PRINT "OE";
70   PR#0:INPUT OE
80   IN#0
90   PRINT "SERIAL ERROR:":E
100  PRINT "RD-GL ERROR:":OE
```

4.3   Application of Software on the Market

The DXY-885 can be used with many software packages on the market.
Followings are how to use and set up them with DXY-990

IBM PC

(1) Lotus 1-2-3 (For ANSI A or ISO A4 size only)

(Serial Connection, 1200 baud, Non Parity, 8 data bits, 1 stop bit)

Computer side:

[CONFIGURE]
Graphics device : H/P 7550A
Interface   : Serial Port
Baud rate   : 1200

DXY-990 side:
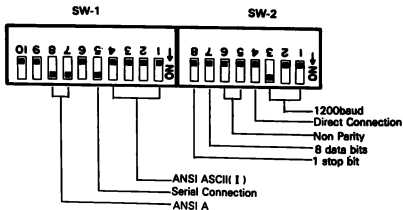
Fig.4-9

Lotus 1-2-3 is a trademark of Lotus Development Corporation.
H/P is a trademark of Hewlett-Packard Company.

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(2) Super Calc 3

(Serial connection, 1200 baud, Even Parity, 7 data bits, 1 stop bit)

    Computer side:

        [DEVICE SELECTION]
          Plotters   : H／P 7475A
        [OPTIONS]
          Serial Options : Com number 1.
                         Baud Rate 1200
                         Parity Even
                         Data bits 7.
                         stop bit 1.

    DXY-990 side:
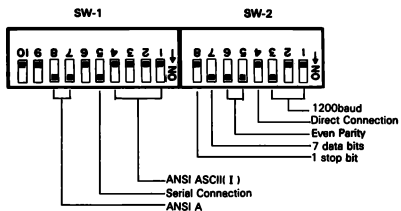
Fig.4-10

(3) AUTOCAD

(Serial connection, 9600 baud, Even Parity, 7 data bits, 1 stop bit)

    Computer side:

    [Configure AUTOCAD]
    Plotter   : Hewlett-Packard
                       HP model 7475

DXY-990 side:

- 9600baud
- Direct Connection
- Even Parity
- 7 data bits
- 1 stop bit
- Font ANSI ASCII(I)
- Serial Connection
- Paper size ANSI B size
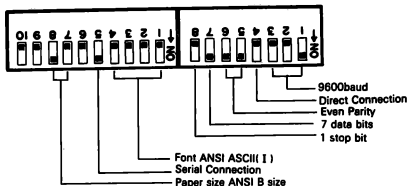
Fig.4-11

(4) CADKEY
(Serial Connection, 9600 baud, Non Parity, 8 data bits, 1 stop bit)

Computer side;

〔Plotfast Program〕
Plotter : HP TYPE 1
Papersize : B
Baud rate : 9600

DXY-990 side:

SW-1   SW-2

- 9600baud
- Direct Connection
- Non Parity
- 8 data bits
- 1 stop bit
- Font ANSI ASCII
- Serial Connection
- ANSI B
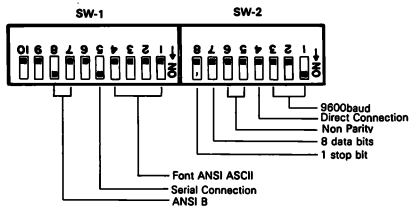
Fig.4-12

(5) PEACHTREE SOFTWARE Business Graphics System
(Serial Connection, 2400 baud, Even Parity, 7 data bits, 1 stop bit)

CADKEY is a trademark of Micro Control System,INC.
PEACH TREE software is a trademark of Peachtree Software inc.
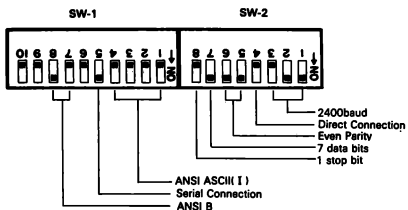
Fig.4-13

(6) Lotus Symphony

(Serial Connection, 4800 baud, Non Parity, 8 data bits, 1 stop bit)

Computer side:
[Hardware]

Plotter	: H／P 7475A
Interface	: Serial port
Baud rate	: 4800

DXY-990 side:
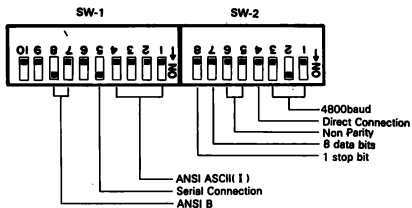
Fig.4-14

Symphony is a trademark of Lotus Development Corporation.

(7) Pfs : GRAPH
(Serial Connection, 1200 baud, Even Parity, 7 data bits, 1 stop bit)

Computer side:

Set the Super Serial Card as shown on Fig.4-6.

DXY-990 side:
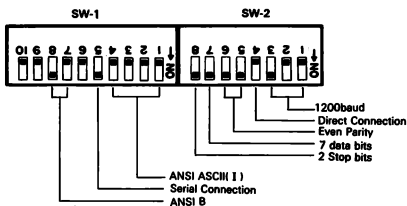
Fig.4-15

Pfs GRAPH is a trademark Software Publishing Corporation

5. RD-GL 1

RD-GL 1 (Roland DG Graphic Language1) is a systematically composed high perfor-
mance language.
The RD-GL 1 is composed of 56 commands and compatible with Hewlett Packard "HP-
GL™" of HP-7475, 7470.

5.1 Semantics of RD-GL 1

The plotting Instructions transmitted from the computer to the plotter are composed of
the following.

    Command······assigns the plotter to carry out operations.
    Parameter······consists of numerical values and characters required for operation.
    Delimiter······distinguishes each command or parameter when they are put
                together such as between a command and a parameter or between
                two parameters.
    Terminator······indicates the end of the command.

The following are typical formats

```
PA    5000   ,   5000   :
               │   │   │   └── Terminator
               │   │   └────── Delimiter
               │   └────────── Parameter
               └────────────── Command
```

5
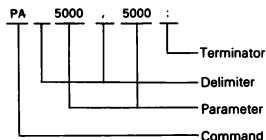
Fig. 5-1

Command
A command comes in two capital letters and assigns various instructions to the plotter
to execute.
In the Fig. 5-1, the command assigns the pen to move to the coordinate indicated by
the parameter.
There are three kinds of commands; a command with no parameter; a command with
parameters; and a command with parameters which can be omitted.

Parameter
A parameter consists of coordinate values or characters that are required for a com-
mand. Fig. 5-1 shows that the pen is move to the coordinate value 5000, 5000. A "+"
can be omitted.

Delimiter
When there are some parameters in the plotting instructions format, individual parameters can not be distinguished.
To solve this, a comma, "," or a one character space can be inserted between parameters. This is called a delimiter. A "+" or "−" of a parameter can also be used as a delimiter. As many delimiters can be used as necessary.
The delimiters between command and parameter can be omitted since the plotter can distinguish them; however they cannot be omitted between parameters.

Terminator
·A terminator indicates the end of a command and a semicolon (;) is used. A terminator can be omitted when another command follows; otherwise it cannot be omitted.
The above mentioned is well illustrated in the following drawing.
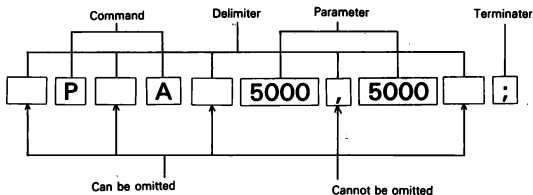
Fig.5-2

The SM and DT command regards the character that follows a command as a symbol or a level terminator.
The parenthesised parameters in the command Explanation Format can be omitted. The commands with these omittable parameters, other than the FT and the UC commands, set the default values if parameters are omitted.
As for the LB command, a level terminator set by the DT command on the terminator is used. If not set, ETX (CHR$(3)) of the default value is used.

                    LPRINT "PA5000, 5000;"
                    PRINT #1, "PA5000, 5000;"

The above may vary depending on the type of computer or the Basic language. For details, refer to the manuals of computer or BASIC, used.

5.2 Coordinate System

5.2.1 Maximum Plotting Area

·The range and Maximum Plotting Area of the plotter varies according to the way different sizes of paper are set.
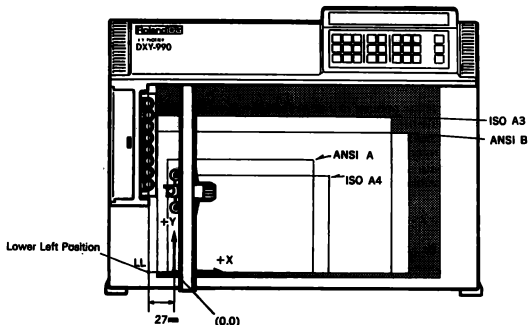
Fig. 5-3

In Fig.5-3, ISO A3, ANSI B, ISO A4 ANSI A indicate the paper size and can be changed either the DIP switch 1-⑦, 1-⑧ or the PS command.
Using a Positioning keys on the panel or the LL, UR key can move the pen outside of this area but will limit the drawing area. The size of each plotting area is indicated by mm unit and plotter units.

	X×Y(mm)	X×Y (plotter units)
ISO A4	276.000×193.025	11040×7721
ISO A3	403.950×276.000	16158×11040
ANSI A	259.125×199.050	10365×7962
ANSI B	416.000×259.125	16640×10365

Table 5-1

5.2.2 Plotter Coordinate

The DXY-990 is capable of assigning up to 40 points in 1mm for both X and Y directions. Other points cannot be assigned. The concurrent point of these is called the plotter coordinate and its origin is at the lower left position of the plotting area.

The X and Y directions are shown in Fig. 5-3.
The distance between the two points, that encompasses a plotter coordinate, is one plotter coordinate unit that is, 0.025mm. No smaller values can be assigned.

The plotter coordinate cannot be changed by commands as it is set by the coordinate system of the plotter.

5.2.3 User Coordinate

A user coordinate can set any origin or any coordinate unit. Once a user coordinate is set, coordinate parameters of command are executed following a user coordinate. Setting a user coordinate is called "scaling".
For details, refer to "5.3 Scaling" in Chapter 5.
Any coordinate units can be set but the values that can be handled as the coordinate are limited within the range shown in Fig. 5-4.

(+32767.4999,+32767.4999)

Maximum
Plotting Area
in plotter coordinate system

(0,0)

Parameter settable area

(−32768.0000,−32768.0000)
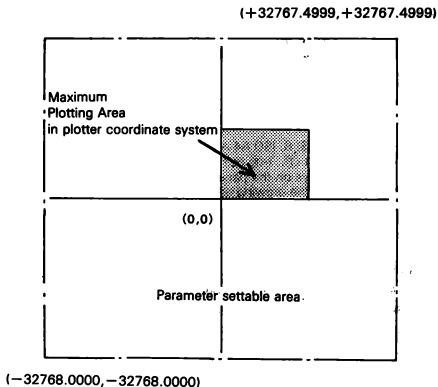
Fig. 5-4

If a coordinate is assigned outside the parameter settable range as shown in Fig. 5-4, an error will occur.

When setting a user coordinate, the plotting area has to be set within the parameter setting range.

The coordinate values can be calculated up to decimal fraction 4 but setting values too small may affect the analyzing capability.

5.3 Scaling

Setting a user coordinate on the plotter is called "scaling".

Scaling enables the setting of coordinate units, and enlargement or reduction of drawings, to meet the user's purposes. The coordinate as a parameter of command follows the plotter coordinate until scaling is executed.

Afterwards it follows the user coordinate while drawing.

5.3.1 Scaling Points P1 and P2

This is the standard point of scaling. The scaling points P1, P2 can be set anywhere in the plotting area.

To scale, set the P1, P2 positions, and decide the coordinate value for these points by executing SC command.

Scaling cannot be done by just setting P1 and P2 positions.

P1, P2 positions can also be set by the control panel.

Move the pen to your desired point by pressing a positioning key. Press the P1 key while pressing the ENTER key and a P1 position will be set. In the same way press the P2 key while pressing the ENTER key and the position will be set as P2.

If P1 is set, P2 will also automatically move the same distance as P1. In this case, P1 can be set while P2 is set outside the plotting area. But by executing IP command, if P1 is set while P2 is set outside the plotting area, an error will occur.

The P1, P2 positions can be confirmed by the control panel by pressing either the P1 or the P2 key as the pen moves towards the set position. If P2 is set outside the plotting area, the pen moves towards it and stops at the boundary of the plotting area.

As for the default values of P1, P2 and setting by executing commands, refer to chapter 6 "RD-GL 1 Commands Explanation, IP Command".

5.3.2 Scaling by Executing the SC Command

The SC command decides the coordinate values for P1, P2 that are set at the desired positions.
For example,
"SC 0,1,0,1;"
If the above is transmitted, P1 is set 0,0 and P2 is set 1,1. If P1and P2 are set as shown is Fig. 5-5, each will be set (0,0) and (1,1) respectively.
A user coordinate can also be set outside P1, P2 as shown in Fig. 5-5.
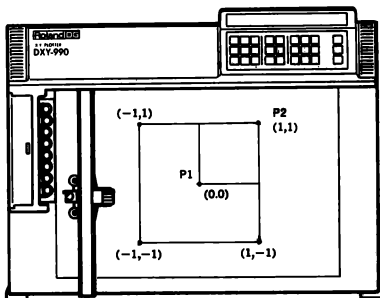
Fig. 5-5

With the combinational execution of IP command and SC command, the coordinate can be set at your desired position. Also by setting, useful values for drawing, the programing loads can be reduced.
The setting functions of P1, P2 can also be used by the control panel for enlargement or reduction of drawings, or graphics.

5.4   Window

The plotting area set by the IW command is called the "window". The default value of the window is the maximum plotting area. (Refer to "5.2.1 Maximum Plotting Area" in this chapter.

The drawing cannot be done outside the window even if a command is executed to draw; however, this will not cause an error.

Window

When drawing is down outside the window the dotted lines in the picture are not drawn.

Fig. 5-6

When drawing is down only outside window, nothing is drawn at all.
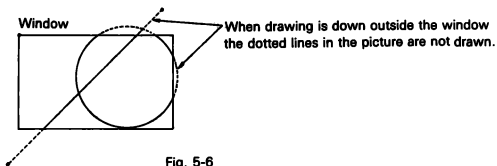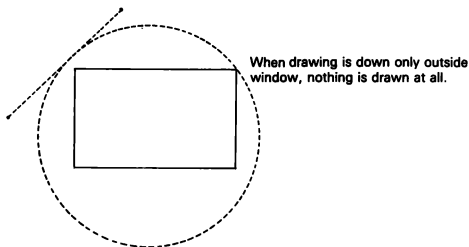
Fig. 5-7

5.5 Selection of Character Set

The DXY-990 provides 19 kinds of character sets (0~4, 6~9, 30~39) which are used to plot character fonts other than English.
Codes and characters differ depending on the set. (Refer to "8.6 Character Code Table" in Chapter 8.
The plotter is capable of assigning two character sets out of the 19 character sets as the Standard Character set and the Alternate Character set. The CS command assignes the standard character set and the CA command assignes the Alternate Character set.
After executing the commands, the parameter assigns the character set number. In case there are no parameters after executing the commands, or at initialization, Character sets are assigned for the Standard Character set and the Alternate Character set by the DIP switch on the rear panel.
However in this case, the character sets are limited to 0~4, 31and32 only. For details, refer to "8.4 DIP Switch Setting Table" in chapter 8.
The SS and the SA command, select a character set for plotting. The SS command or the SI (CHR$(15)) select the standard character set and the SA command or the SO (CHR$(14)) select the alternate-character set. If it is not clear whether the standard character set or the alternate-character set is being selected, input the SS command and the SA command before the character plotting command.

The above mentioned is well illustrated in the following drawing.
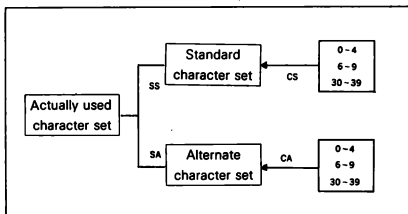
Fig. 5-8

If different character sets are assigned for the standard character set and the alternate-character set respectively, at the begining of programing, a character set can be changed easily by executing the SS command and the SA command Using two different characters in plotting can be done by executing the character plotting command (LB) in corporated with the SI (CHR$(15)) and the SO (CHR$(14)).

The following is a simple example.
10 LPRINT "CS0;"
20 LPRINT "CA8;"
30 LPRINT "SP1; LB";CHR$(15);"ABC";CHR$(14); "ABC"; CHR$(3)
40 END

When executing the above, the standard character set and the alternate character set are mixed and plotted as follows:

ABCチツテ

When drawing the marks surrounded by dotted lines in "8.6 Character-Code table"in
chapter8, one character space returns automatically. Therefore, if you want to put an
additional mark on the character, plot the character frist. An additional mark should be
added later.

5.6 Digitizing

The DXY-990 is equipped with not only plotter functions but with digitizer functions as
well. In the digitizing mode, the plotter is able to out put manually detected coordinate
values, the pen status (up/down) at the current pen position to the computer.

**Note: Digitizing is only effective when the serial connecttion is applied since the
computer receives signals from the plotter. If a parallel connection is ap-
plied, the computer cannot receive the information outputted from the plot-
ter.**

5.6.1 Digitizing by Manual

When the plotter receives the DP command, it enters the DIGITIZE MODE and the
Digitizing mode indicator goes on indicating that it is ready to digitize.
If the ENTER key on the Control Panel is pressed, the X, Y coordinate values and the pen
status (up/down), at the current pen position are stored in the plotter and the in-
dicator goes off.
The values can be outputted in ASCII code by exeuting the DC command.

The following are simple examples:

The Digitizing Mode enters at the 110th line.
In this condition, a pause status will enter at the 120th line until the ENTER key of the
plotter and the RETURN key of the computer pre pressed.
The computer will start reading data from the plotter at the 140th line.

```
(Example)
100 "COM1:9600,N,8,1"AS#1
110 PRINT#1,"DP;"
120 INPUT"READY";R
130 PRINT#1,"OD;"
140 INPUT#,X,Y,P
150 PRINT X,Y,P
160 PRINT#1,"DC;"
170 END
```

5.6.2 Digitizing by Status Byte

As for the Digitizing Mode of 5.6.1, programing should be stopped (pause) until the
ENTER key of the plotter and the RETURN key of the computer are pressed.
In the Digitizing Mode, pressing the RETURN key sets the bit 2(bit value 4) of 8 bit
status byte in the plotter.
Executing the OS command causes the computer to read the contents of the status
byte and advances to the OD command if the third bit value is set at 1.
This sample program is shown below.

The computer reads the status byte from the 1000th lin to the 1400th line, providing
the value is set at 1.
Since the OD command clears this byte, the computer can output at the 130th line, can
read at the 140th line, and can detect the status byte.
For these reasons, pressing the RETURN key on the control panel provides vauious digitiz-
ings.

```
(Example)
100 OPEN"COM1:9600,N,8,1"AS#1
110 PRINT#1,"DP;"
120 GOSUB 1000
130 PRINT#1,"OD;"
140 INPUT#,X,Y,P
150 PRINT X,Y,P
160 GOTO 110
1000 PRINT#1,"OS;"
1100 INPUT#1,S
1200 S=INT(S/2)
1210 S=INT(S/2)
1220 S=S MOD 2
1300 IF S=0 THEN 1000
1400 RETURN
```

6.RD-GL1 Commands Explanation

In this chapter, the character code (ASCII Code) uses a decimal scale, and BASIC language CHR$(character code) is used, which provides characters corresponding to each character code.
Especially in the case of the control character, ESC (CHR$(27)) or ESC is used.

In the explanation, the example of BASIC language are typical formats in BASIC. Please change them according to the computer being used.

The parenthesised parameters in the "FORMAT" can be omitted. In the "EXAMPLE" concrete example are given in BASIC language.
PRINT #1, INPUT #1, indicates the INPUT/OUTPUT of RS-232C. In this case, the file should be opened in advance. "PARAMETER RANGE" is the value above which an error will occur. There are value which carry no parameters or are ignored even if they are within the parameter range.

"AA" COMMAND

The Arc Absolute Command

FUNCTION
Used to draw an arc centered on the specified X and Y coordinates.

FORMAT
AA X,Y,θc(,θd) [terminator]

EXAMPLE
LPRINT "AA 6000,5000,360,10;"

PARAMETER RANGE
X,Y: Center coordinates   −32768.0000 to +32767.4999
θc : Center angle   −32768.0000° to +32767.4999°
θd : Resolution   −32768.0000° to +32767.4999° (default value: 5°)

DESCRIPTION
Draws an arc centered on the specified X and Y absolute coordinates, by the angle specified at θc, commencing from the current pen position. If more than a 360° angle is designated to θc, the drawing is done overlapping in the same location.
The resolution parameter specifies the smoothness of the arc.
The parameter is specified as an angle (°). The smoothest circle are drawn when 0° is designated to θd. θd's effective range is from 0° to 180°. If less than 0° is designated, 0° will be set and if more than 180° is designated, 180° will be set. If the parameter is not specified, 5° is set.
Specified θd is adjusted into positive numbers to divide θc equally.
As well as drawing circles and arcs, the resolution θd may be altered to enable drawing of the desired polygon.

Example

```
100 REM ***ARC ABSOLUTE SAMPLE ***
110 LPRINT "PA;PU8000,6000;"
120 FOR I=1 TO 5
130   READ A:D=360/A
140   LPRINT "SP";I;";PD;AA6000,5000,360,";D;";"
150 NEXT I
160 LPRINT "PU;":END
170 DATA 20,12,8,5,3
```
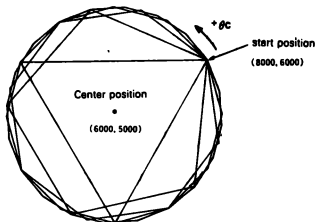

Fig. AA-1

"AR" COMMAND

The Arc Absolute Command

FUNCTION
Used to draw an arc centered on the specified X and Y relative coordinates starting from the current pen position.

FORMAT
AR ΔX,ΔY,θc(,θd) [terminator]

EXAMPLE
LPRINT "AR 0,200,360,10;"

PARAMETER RANGE
ΔX, ΔY : Center coordinates   −32768.0000 to +32767.4999
θc : Center angle   −32768.0000° to +32767.4999°
θd : Resolution   −32768.0000° to +32767.4999° (default value: 5°)

DESCRIPTION

The AR command draws an arc, centered on a specified X, Y relative coordinates star-
ting from the current pen position. If more than a 360° angle is designated to θc, the
drawing is done overlapping in the same location. The angle of the arc is specified by
θc. θd specifies the smoothness of the arc. The smoothest circle are drawn when 0° is
designated to θd. θd's effective range is from 0° to 180°. If less than 0° is designated,
0° will be set and if more than 180° is designated, 180° will be set.
Specified θd is adjusted into positive numbers to divide θc equally. The parameter value
is specified in units of degree (°).

Example

```
100 REM ***ARC ABSOLUTE SAMPLE ***
110 LPRINT "SP1;PA;PU6000,2000;"
120 LPRINT "PD;AR0,−500,360,10;"
130 LPRINT "PU;"
```
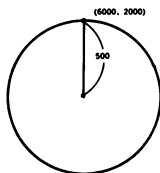

Fig. AR-1

"CA" COMMAND

The Designate Alternate Character Set Command

FUNCTION

CA command designates one of the character sets to be used as an alternate character
set.

FORMAT

CA character set number [terminator]
CA [terminator]

EXAMPLE

LPRINT "CA 1;"
LPRINT "CA ;"

PARAMETER RANGE
Designates an alternate character set in the same manner as the CS command.
Character set number can be from 0-4, 6-9, or 30-39. The CA command with a
parameter out of the specified range will cause an error and the command will be ig-
nored. Note that a character set designated by the CA command can only be printed
when it is selected as an alternate character set by the SA command or [SO](CHR$
(14)). For details refer to "5.5 Selection of Character Set" in Chapter 5.

"CI" COMMAND

The Circle Command

FUNCTION
Used to draw a circle centered on the current pen position.

FORMAT
CI r(,θd) [terminator]

EXAMPLE
LPRINT "CI 1000;"

PARAMETER RANGE
r : Radius   −32768.0000 to +32767.4999
θd: Resolution   0° to 32767.4999° (default value: 5°)

DESCRIPTION
The CI command draws a circle of radius r centered on the current pen position. The
specification of a parameter θd can be used to draw polygons. For example, θd=60°
forms a hexagon; θd=45° forms an octagon. If θd is omitted, the default value of 5° is
used.
θd specifies the smoothness of the arc. The parameter value is specified in units of
degree (°).
The smoothest circle are drawn when 0° is designated to θd. θd's effective range is
from 0° to 180°. If less than 0° is designated, 0° will be set and if more than 180° is
designated, 180° will be set.

[Example]

```
100 REM ***CIRCLE SAMPLE ***
110 LPRINT "SP1;PA;PU6000,1500;"
120 LPRINT "CI1000;"
```
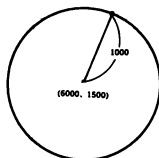
Fig. CI-1

"CP" COMMAND

The Character Plot Command

FUNCTION
CP command moves the pen by the designated number of character-space fields.

FORMAT
CP number of character-space fields in X-direction, number of character-space fields in Y-direction [terminator]
CP [terminator]

PARAMETER RANGE
−128.0000 to +127.9999

EXAMPLE
LPRINT "CP 10,−2;"
LPRINT "CP;"

DESCRIPTION
Character cell refers to an area of a character including spacing between characters.
Relationship between character cell and character size is as shown in Fig. CP-1.
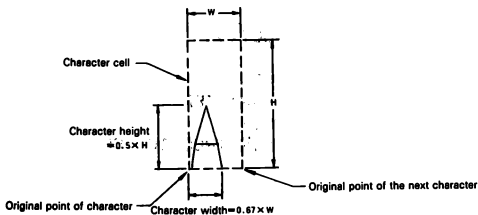
Fig. CP-1

Parameters are values within -128 to $+127$, a positive value moves the pen right or up, or a negative value moves it left or down. The parameter varies according to the character size. Note that the direction varies with print direction as shown in Fig. CP-2.
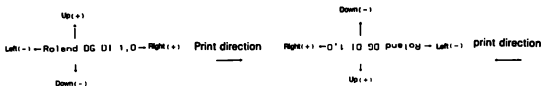
Fig. CP-2

The CP command with no parameters provides carriage return $\boxed{CR}$ (CHR$(13)) and line feed $\boxed{LF}$ (CHR$(10)).
Since the CP command designates a moving distance of the pen by the number of character-space fields, it can be more conveniently used in printing than the PA or PR command.
A print example using the CP command follows. Note the left flush printing along the line. The following program shows the use of the CP command, which results in the left flush printing.

(Example)

```
100 REM ***"CP" COMMAND***
110 LPRINT "IN;PA3000,3000;"
120 LPRINT "SP1;SI;"
130 LPRINT "LBCP INSTRUCTION";CHR$(3)
140 LPRINT "CP-7,-2;PR0,0;"
150 LPRINT "LBTHE";CHR$(3)
160 LPRINT "CP;LBCHARACTER";CHR$(3)
170 LPRINT "CP;LBPLOT";CHR$(3)
180 LPRINT "CP;LBCPINSTRUCTION,CP";CHR$(3)
190 LPRINT "SP0;"
```

CP INSTRUCTION

THE
CHARACTER
PLOT
CPINSTRUCTION,CP

Fig. CP-3

"CS" COMMAND

The Designate Standard Character Set Command

FUNCTION
CS command designates one of the character sets to be used as the standard character set.

FORMAT
CS character set number [terminator]
CS [terminator]

EXAMPLE
LPRINT "CS 1;"
LPRINT "CS;"

PARAMETER RANGE
Designated by the DIP switch

DESCRIPTION
DXY-990 has nineteen character sets. These are to plot character fonts other than English. Character sets number can be 0-4, 6-9, or 30-39. Refer to "8.6 Character Code Table" in Chapter 8.
The CS command with a parameter other than specified will cause an error and the command will be ignored.
No parameter or initialization designates a character set designated by the DIP switch setting both for the standard character set and alternate character set.
For the relation to the CA,SA and SS commands refer to "5.5 Selection of Character Set" in Chapter 5.

(For serial connection only)

"DC" COMMAND

The Digitize Clear Command

FUNCTION
The DC command terminates the digitize mode.

FORMAT
DC [terminator]

EXAMPLE
PRINT #1,"DC;"

DESCRIPTION

When the DC command is received, the digitize mode is terminated, and DIGITIZE MODE LED stops lighting.

Coordinates are not stored. The DC command uses no parameter. For details, refer to "5.6 Digitizing" in Chapter 5.

"DF" COMMAND

The Default Command

FUNCTION

DF command sets the plotter to the default status.

FORMAT

DF [terminator]

EXAMPLE

LPRINT "DF;"

DESCRIPTION

Sets the character size and slant to the default status (see Table DF-1) but the position of scaling points of P1 and P2 remain unchanged.

Function	Equivalent command	Conditions
Plotting mode	PA;	Absolute coordinates
Printing direction	DR;	Right horizontal
Line type	LT;	Solid line
Line pattern length	LT;	4% of diagonal line of P1 and P2
Input Window	IW:	Mechanical limit of plotter
Character size	SR;	Width = 0.75% of (P2x−P1x)
		Height =1.5% of (P2x−P1y)
Symbol mode	SM;	Off
Scale length	TL;	x scale = 0.5% of (P2x-P1x)
		y scale = 0.5% of (P2y-P1y)
Standard character set	CS;	Value set by the DIP switch
Alternate character set	CA;	Value set by the DIP switch
Character set	SS;	Standard character set
Character slant	SL;	0°
Digitize mode	DC;	Cleared
Scaling	SC;	Not scaled
Pen speed	VS;	300mm/s
Label terminator	DT CHR$(3);	ETX (CHR$(3))

Table DF-1

"DI" COMMAND
The Absolute Direction Command

FUNCTION
DI command designates print direction.

FORMAT
DI run,rise [terminator]
DI [terminator]

EXAMPLE
LPRINT "DI 1, 0;"
LPRINT "DI;"

PARAMETER RANGE
−128.0000 to + 127.9999

DEFAULT VALUE
"DI 1, 0;"

Fig. DI-1

DESCRIPTION
The DI command designates an absolute direction, independent of the positions of P1 and P2.
Relationship between the two parameters, run and rise, designates a direction as shown in the Fig. DI-1. Run and rise are values within −128.0000 to +127.9999, rise = 0 designates horizontal direction and run = 0 vertical direction. If both are zero, an error will be caused. For a known print angle θ, "DI"; cosθ, ","; sinθ, ";" can be executed. The DI command with no parameters will default to the values DI 1, 0 (horizontal). If a single or three or more parameters are used, the command will be ignored.

A direction set by the DI command remains effective until a new DI or DR command is executed or not set to the default value by the IN or DF command. An example of the DI command is shown in the Fig. DI-2.
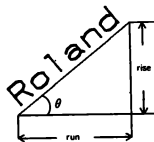
Fig. DI-2
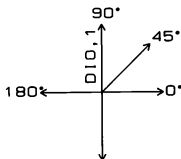
	run	rise
0°	I	0
45°	I	I
90°	0	I
135°	− I	I
180°	− I	0
225°	− I	− I
270°	0	− I
315°	I	− I

(Example)

```
100   REM ***"DI"Command ****
110   LPRINT "IN;SP2;PA4000,-3000;"
120   LPRINT "DI1,1;LB  --45deg--  ";CHR$(13);CHR$(3)
130   LPRINT "DI0,1;LB  --90deg--  ";CHR$(13);CHR$(3)
140   LPRINT "DI-1,1;LB  --135deg--  ";CHR$(13);CHR$(3)
150   LPRINT "DI-1,0;LB  --180deg--  ";CHR$(3)
160   LPRINT "PR0,0;"
170   LPRINT "DI-1,-1;LB  --225deg--  ";CHR$(13);CHR$(3)
180   LPRINT "DI0,-1;LB  --270deg--  ";CHR$(13);CHR$(3)
190   LPRINT "DI1,1;LB  --315deg--  ";CHR$(13);CHR$(3)
200   LPRINT "DI;LB  --DI COMMAND--  ";CHR$(13);CHR$(3)
```
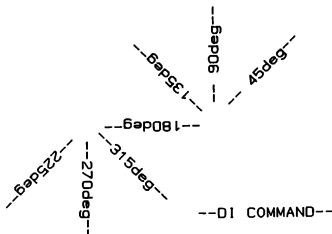

Fig. DI-3

"DP" COMMAND

The Digitize Point Command

FUNCTION
The DP command sets the plotter to the digitize mode.

FORMAT
DP [terminator]

EXAMPLE
PRINT #1,"DP;"

DESCRIPTION
Receiving the DP command, the plotter is set to the digitize mode and ready to digitize, and DIGITIZE MODE LED is lighted.
By pressing the ENTER key, X and Y coordinate values of the current pen position and pen up/down condition are stored in the plotter. At the same time, bit 2 of the status byte is set and data of the digitized point are ready to be output.
The DP command uses no parameter.

"DR" COMMAND
The Relative Direction Command

FUNCTION
DR command designates print direction in rations to length in X and Y-directions between scaling points P1 and P2.

FORMAT
DR run,rise [terminator]
DR [terminator]

EXAMPLE
LPRINT "DR 1,0;"
LPRINT "DR;"

PARAMETER RANGE
−128.0000 to +127.9999 (%)

DEFAULT VALUE
"DR 1,0;"
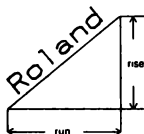
Fig. DR-1

DESCRIPTION
Parameter "run" for the DR command designates a percentage (%) to P2x - P1x and parameter "rise" a percentage (%) to P2y - P1y. Relationship between run and rise is as shown in the Fig. DR-1. None that print direction varies with the positions of scaling points P1 and P2. Values of run and rise should be within −128.0000 to 127.9999, rise = 0 designates horizontal or run = 0 designates vertical deraction. If both are zero, an error will be caused.
The DR command with no parameters defaults to the values DR1,0 (horizontal direction). A single or more parameters will cause an error and the command to be ignored.
Sign of parameter is determined according to the quadrant of the print direction, with the current pen position as the original print, as shown in the Fig. DR-2.
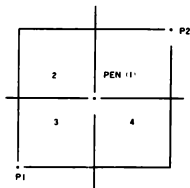
	r u n	r i s e
①	+	+
②	−	+
③	−	−
④	+	−

Fig. DR-2

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"DT" COMMAND

The Defined Terminator Command

FUNCTION
The DT command specifies the character to be used as the label terminator, which is to release the plotter from print mode.

FORMAT
DT character [terminator]

EXAMPLE
LPRINT "DT";CHR$(3);";"

DESCRIPTION
The DT command is used to change the label terminator when the standard setting label terminator ETX (CHR$(3)). cannot be used.
The ASCII control character NULL (CHR$(0))cannot be defined as a label terminator, however, normal function of the character is also executed, or printed if it is a printable character. For example, when LF (CHR$(10)) is defined as a label terminator it releases the print mode and, at the same time, mades line feed. When "Z" is used as a label terminator, the print mode is released and "Z" is drawn at the end of the print. Normally, it is recommended to used a control code as a label terminator.

The DT command with no parameter does not re-set the label terminator to ETX (CHR$(3)), because the command "DT;" defines ";" as a label terminator.
Therefore, use the DF or IN command, or execute "DT";CHR$(3);";", to re-set the label terminator to ETX (CHR$(3)).

"EA" COMMAND

The Edge Rectangle Absolute Command

FUNCTION
Used to draw a rectangle which is specified diagonally with the current pen position and X, Y coordinate values.

FORMAT
EA X,Y [terminator]

EXAMPLE
LPRINT "EA 2500,3000;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION

An EA command without parameters is ignored.
Draws a rectangle specified with the X and Y coordinates value. Drawing begins from
the current pen position.
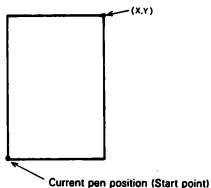
Fig. EA-1

The drawing direction and position change in accordance with the parameter values for
the pen position.
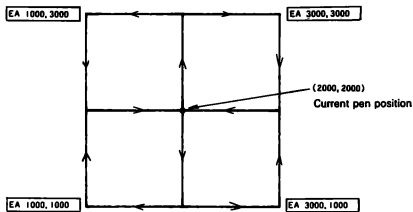
Fig. EA-2

(Example)

```
100 REM ***BOX SAMPLE (1)***
110 LPRINT "SP1;PA;PU1000,1000;"
120 LPRINT "EA2000,2000;"
```

(2000, 2000)·

(1000, 1000)
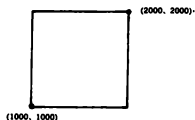
Fig. EA-3

"ER" COMMAND

The Edge Rectangle Relative Command

FUNCTION
Used to draw the inside of a rectangle which is specified diagonally with both the current pen position and X, Y increments

FORMAT
ER ΔX,ΔY [terminator]

EXAMPLE
LPRINT "ER 1500,2000;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION
An ER command without parameters ignored.
Draws a rectangle specified with the X and Y increments. Drawing begings from the current pen position.

(X increment, Y increment)

Current pen position (Start point)
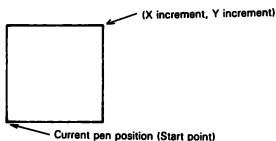
When drawing is completed, the pen returns to the start position.

Fig. ER-1

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·.The drawing direction and position change in accordance with the sign of the parameter.
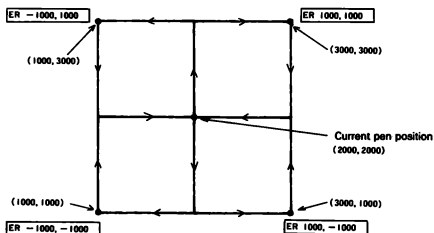
Fig. ER-2

(Example)

```
100 REM ***BOX SAMPLE (2)***
110 LPRINT "SP1;PA;PU2000,2000;"
120 LPRINT "ER1000,1000;"
```
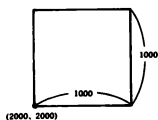

Fig. ER-3

"EW" COMMAND
The Edge Wedge Command

FUNCTION
Used to draw a wedge.

FORMAT
EW r,θ1,θc(,θd) [terminator]

EXAMPLE
LPRINT "EW 1000,90,180,5;"

PARAMETER RANGE
X,Y: Center coordinates −32768.0000 to +32767.4999
θ_1: start angle −32768.0000°to +32768.4999°
θ_c: Center angle −32768.0000°to +32768.4999°
θ_d: Resolution −120°to +120°(default value: 5°)

RELATED COMMAND
WG

DESCRIPTION
This command is ignored unless the parameter is specified.
When drawing is completed, the pen returns to the start position.
As the base point differs with the sign of the radius parameter, care is required with its specification. The angle relative to the base point differs according to the sign of the start and center angle parameters.

Resolution specified the smoothness of circuler arc of the wedge. The parameter is specified, as an angle (°). The total number of chords par arc is limited to 90. For example, when $\theta c=360°$ and $\theta d = 0°$, Resolution θd is set 4°.If resolution is not specified, 5° is set. Specified θd is adjusted into positive numbers to divide θc equally.

The drawing direction changes in accordance with the sign of the parameter.
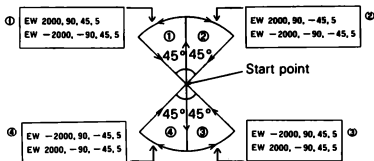
Fig. EW-1

(Example)

```
100 REM ***ARC SAMPLE ***
110 LPRINT "SP1;PA;PU5000,5000;"
120 FOR I=1 to 4
130   READ A$
140   LPRINT "EW";A$
150 NEXT
160 DATA "−2000,−90,45,5;","−2000,−90,−45,5;"
170 DATA "2000,−90,−45,5;","2000,−90,45,5;"
160 DATA "−2000,−90,45,5;","−2000,−90,−45,5;"
170 DATA "2000,−90,−45,5;","2000,−90,45,5;"
```
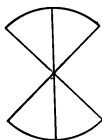
Fig. EW-2

"FT" COMMAND

The Fill Type Command

FUNCTION
Used in conjunction with the RA, RR and WG commands to specify shading and hatc-
ing type. .

FORMAT
FT n(, d(, θ)) [terminator]
FT [terminator]

EXAMPLE
LPRINT "FT 3;"

PARAMETER RANGE
n: Type   1 to 5
d: Spacing   0 to 32767.4999
θ: Angle . −32768.0000° to +32767.4999°

DEFAULT VALUE
n = 1
d = (P2−P1)×0.01
θ = 0°

DESCRIPTION
n: Type
The following three types are specified by number.
1   : Bidirectional shading (■■■)
2   : Unidirectional shading (■■)
3   : Hatcing (■■■) .
4   : Cross hatcing (■■■)
5   : Ignored
If the type is not specified, the default value of 1 is set.

d: Spacing
Used to specify the spacing between the parallel lines used for hatching and cross hat-
ching. When "n" is 1 or 2, this parameter is ignored and the value specified with the PT
command is used.
When "d" is not specified, the "d" value specified with the previos FT command is set, if
there in no previous FT command, the default value (1% of the P1,P2 spacing) is set.
"d" is ignored if specified as 0 and the PT command value specified at that time is us-
ed.

θ: Angle
Specifies the angle of the lines used for shading and hatching in increments of 45°. If 0
is specified, horizontal lines are drawn, if 90 is specified, vertical lines are drawn and if
45 is specified, lines at 45° are drawn. If the angle is not specified, or if other than
multiples of 45 are specified, the value specified with the previous FT command is set,
if there is no previous FT command, 0 is set.

"IM" COMMAND

The Input Mask Command

FUNCTION
The IM command sets the condition to notify the computer of a plotter error.

FORMAT
IM error mask value [terminator]
IM [terminator]

EXAMPLE
LPRINT "IM 223;"
LPRINT "IM;"

DESCRIPTION
Error mask value is a sum of bit values (see Table IM-1) of errors to be known. If an er-
ror of designated bit value generates, the ERROR LED on the front panel will flash.
For example, the standard error mask value, 223 (128 + 64 + 16 + 8 + 4 + 2 + 1)
will cause the ERROR LED to flash when an error other than Error 6 generates.
Since Error 4, Error 7 and Error 8 are not used, an error mask value of 23 other than the
above the same effect as the standard setting, 223.

Error mask bit value	Error No.	Meaning
1	1	Unrecognizable command exected
2	2	Wrong number of parameters
4	3	Parameter out of range
8	4	Unused
16	5	Unsable character designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unsed

Table IM-1

The OE command can be used to know the error meaning when the ERROR LED of the plotter is flashing.
Error mask value is set to 223 by the standard or initial setting.
The IM command with no parameter or with a parameter out of the range sets the error mask value to the standard setting value, 223.

"IN" COMMAND
The Initialize Command

FUNCTION
IN commands set the plotter to the same initial status as the default status.

FORMAT
IN [terminator]

EXAMPLE
LPRINT "IN;"

DESCRIPTION
Performs the following setting in addition to the default status by the DF command.
∗Pen up (PU;)
∗Sets to the default values of scaling points (IP;)
∗Sets to the default values of rotate coordinate system (RO;)
∗Clears an error and the sets the third bit of the status byte

"IP" COMMAND
The Input P1 and P2 Command

FUNCTION
The IP command relocates scaling points P1 and P2 through program control.

FORMAT
IP P1x,P1y(,P2x,P2y) [terminator]

EXAMPLE
LPRINT "IP 0,10,10000,5000;"
LPRINT "IP;"

PARAMETER RANGE
The parameter range will be the range of the maximum plotting area as shown in Table IP-1, that can be changed by the DIP switch 1-⑦ and ⑧
Decimal fractions are rounded down (for example, 10.5 becomes 10 and −10.5 becomes −10) and the values that are not included in Table IP-1 will be considered error.

(Paper size).

Paper size	X	Y
A3(ISO)	0~16158	0~11040
A4(ISO)	0~11040	0~7721
B(ANSI)	0~16640	0~10365
A(ANSI)	0~10365	0~7962

Maximum plotting area
Table IP-1

DEFAULT VALUE
Default values vary with paper size.

Paper size	P1x,P1y	P2x,P2y
A3(ISO)	170,602	15370,10602
A4(ISO)	603,521	10603,7721
B(ANSI)	522,259	15722,10259
A(ANSI)	250,596	10250,7796

Default values of P1, P2
Table IP-2

DESCRIPTION
Coordinates of P1 and P2 are designated in the plotter coordinates. Therefore, X and Y coordinates must be within the range shown in table IP-1, so that P1 and P2 are within the maximum plotting area.

The IP command without parameter defaults P1 and P2 to the initial values shown in the Table IP-2.
The IP command is used to default P1 and P2 to given values or reset to the initial values. P1 and P2 serve to determine the positions to connect the plotter coordinates inherent in the plotter with user coordinates system having a given scale. User coordinate scale is designated by the SC command.
If the IP command is executed with P2x and P2y omitted, P2x and P2y are moved automatically the same distance that P1x and P1y are moved. That is, the value P2x - P1x and P2y - P1y become the same after execution of the IP command as before execution of the IP command. But by executing IP command, if P1 is set while P2 is set outside the plotting area, an error will occured.

"IW" COMMAND
The Input Window Command

FUNCTION
The IW command is to define a plotting area. This area is called a "window".

FORMAT
IW X1 lower left, Y1 lower left, X2 upper right, Y2 upper right [terminator]
IW [terminator]

EXAMPLE
LPRINT "IW 0,0,100,100;"
LPRINT "IW;"

PARAMETER RANGE AND DEFAULT VALUE
The default value and range of parameter will be the maximum plotting area as shown in Table IW-1 which can be changed by the DIP switch 1-⑦ and 1-⑧. If the window is set over this range, window will be the boundary of the maximum plotting area without error.

Paper Size	X	Y
A3(ISO)	0~16158	0~11040
A4(ISO)	0~11040	0~7721
B(ANSI)	0~16640	0~10365
A(ANSI)	0~10365	0~7962

Maximum plotting area(Default values of the window)
Table IW-1

DESCRIPTION
When the command has four parameters, the window is set according to the parameters. The command without parameter sets the window to the default values shown in Table IW-1.

Four parameters are determined as plotter coordinates and indicate X and Y coordinates of the lower left corner and upper right corner of the window.
If X1 value of the lower left corner is greater than X2 value of the upper right corner, or Y1 value of the lower left corner is greater than Y2 value of the upper right corner, the parameter values are automatically changed, and always X2 is greater than X1 and Y2 is greater than Y1.
Window is set to the default values after the power is switched ON or the IN or DF command is executed.
This command is used to restrict the plotting area when the paper is smaller than the plotting area or when a part of a plotting is to be plotted.
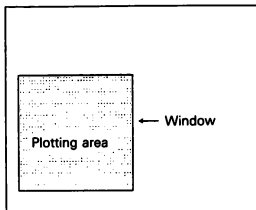
Fig. IW-1

"LB" COMMAND

The Label Command

FUNCTION
Prints a character string until a label terminator defined by the DT command, using a currently designated character set.

FORMAT
LB character string [label terminator]

EXAMPLE
LPRINT "LB Roland DG";CHR$(3)
LPRINT "LB";A;B;CHR$(3)

RELATED COMMANDS
DT,CS,SS,CA,SA,DI,DR,SI,SR,SL

DESCRIPTION
The LB command sets the plotter to print mode. In print mode, all inputs are interpreted as character strings until a label terminator is received. The label terminator is initially set to code ETX (CHR$(3)), which can be changed using the DT command.
Character sets that are used in printing with the LB command include those designated by the CS, SS, CA, or SA command, ASCII code 32 to 127. The direction of character string is designated by the DI or DR command, the size by the SI or SR command, and the slant by the SL command.
In the printing by the LB command, a current pen position is the left lower corner of first character.
Therefore, before executing of the LB command, the pen should be moved to the location where labeling is to begin using one of the plot commands (PA, PR, or CP) or by front-panel controls. Portions projection out of the drawing area will not be drawn.
After that, when carriage return CR (CHR$(13)) is received, the pen returns to the lower left corner of the first character but no line feed is made.
To make both carriage return and line feed, both carriage return CR (CHR$(13)) and line feed LF (CHR$(10)) should be entered. Refer to the example in the paragraph for the CP command in this Chapter.
As special codes, there are back space BS (CHR$(8)), vertical tab VT (CHR$(11)) and horizontal tab (1/2 backspace) HT (CHR$(9)). Variables can be; of course, used as character strings. Two or more consecutive variables are plotted with no blank between variables by using a semicolon as a delimiter between variables. When a comma is used as a delimiter, variables are printed at the right end within a specified space (depending on computer).

"LT" COMMAND

The Line Type Command

FUNCTION
LT command designates a type of dotted-line and its pitch length.

FORMAT
LT pattern number (,pitch length) [terminator]
LT [terminator]

EXAMPLE
LPRINT "LT 1,7;"
LPRINT "LT;"

PARAMETER RANGE
Pattern number: −128 to +127
Picth length: 0 to 127.9999

DEFAULT VALUE
Solid line
4%

DESCRIPTION
The LT command without parameter defines a solid line. Type of dotted-line varies with
the pattern number as follows:
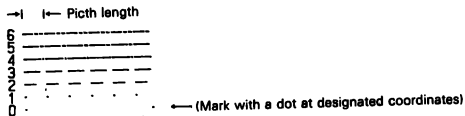
Fig. LT-1

A parameter in the range +7 to +127 is ignored.
Aprameter between −128 and −1 defaults to a solid line. A parameter greater than
128 or less than −128 will cause an erorr. A pattern parameter between −128 and 0
and designating pitch length will cause an error.
The pitch length parameter is effective when the pattern number is within 0 to +127.
This parameter represents the pitch length in percentage of the diagonal line between
scaling points P1 and P2.
When no pitch length is designated, it is set to 4%.

(Example)

LPRINT "LT5;"
LPRINT "PR;PD2000,0,0,1000,−2000,0,0,−1000;PU;"

Fig. LT-2

(For serial connection only)

"OA" COMMAND
The Output Actual Position and Pen Status Command

FUNCTION
The OA command allows plotter coordinates of X and Y of the current pen position and
pen condition (up or down) to be read by a computer.

FORMAT
OA [terminator]

EXAMPLE
PRINT #1,"OA;"

DESCRIPTION
Receiving the OA command, the plotter is ready to output the following three values in ASCII code.

X,Y,P [TERM]

Where X and Y are integer coordinate value of plotter coordinates. P indicate the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the interface connected. For details, refer to "7.6 Device control commands. [ESC].M" in Chapter 7.
This command can be used to manually move the pen to a desired position where a character or pattern is drawn and to know the coordinates, for easy pen positioning and window setting.
Before using the command in an actual program, open a file by using the OPEN statement

PRINT #1,"OA;"
INPUT #1,X,Y,P
PRINT X,Y,P

(For serial connection only)

"OC" COMMAND
The Output Command Position and Pen Status Command

FUNCTION
The OC command allows plotter coordinates or user coordinates of X and Y of the current pen position and pen condition (up or down) to be read by a computer.

FORMAT
OC [terminator]

EXAMPLE
PRINT #1,"OC;"

DESCRIPTION
Receiving the OC command, the plotter is ready to output the following three values in ASCII code.

X,Y,P [TERM]

Where X and Y are coordinate values of plotter coordinates or user coordinates, P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC].M" in Chapter 7.
When being scaled by the IP and SC commands, X and Y are user coordinates between

—32768.0000 and 32767.9999 both for X and Y.
Before using the command in an actual program, open a file by the OPEN statement
from the computer.

        PRINT #1,"OC;"
        INPUT #1,X,Y,P
        PRINT X,Y,P

                                          (For serial connection only)

"OD" COMMAND

The Output Digitized Point and Pen Status Command

FUNCTION
The OD command allows X and Y coordinates of the last digitized point and the pen
condition to be acquired by the computer.

FORMAT
OD [terminator]

EXAMPLE
PRINT #1,"OD;"

DESCRIPTION
When the OD command is received, the plotter is ready to output X and Y coordinates
of the digitized point and the condition in the following ASCII form.

                                X,Y,P [TERM]

Here X and Y are integer formats of plotter coordinates. P is a variable indicating pen
condition, 0 for a pen up and 1 for a pen down condition.[TERM] is output terminator
for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC]
.M" in
When the OD command is received, bit 2 of the status byte is cleared. Before using the
command in an actual program, execute the OPEN statement by the direct command
from the computer to open a file. For details, refer to "5.6 Digitizing" in Chapter 5.

        PRINT #1,"OD;"
        INPUT #1,X,Y,P
        PRINT X,Y,P

"OE" COMMAND

The Output Error Command

FUNCTION
When the OE command is received a computer reads the total bit value showing the meaning of errors generated.

FORMAT
OE [terminator]

EXAMPLE
PRINT #1,"OE;"

DESCRIPTION
Receiving the OE command, the plotter is ready to output an error code in the following ASCII code.

Error code [TERM]

Where [TERM] is an output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC] .M" in Chapter 7.
When the output is completed, bit 5 of the plotter status byte is cleared and the ERROR LED stops flashing.
Error codes are defined as follows.

Bit value	Error NO	Meaning
0	0	No error
1	1	Unrecognizable command
2	2	Wrong number of parameters
4	3	Unusable parameter
8	4	Unused
16	5	Unusable character set designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unused

Table OE-1

The OE command is useful for debugging.
Before using the command in an actual program, execute the OPEN statement by the direct command from the computer to open a file.

```
PRINT #1,"OE;"
INPUT #1,E
PRINT E
```

"OF" COMMAND

The Output Factors Command

FUNCTION
The OF command outputs the number of plotter units per 1mm on the X and Y axis.
This enables knowledge of the size of plotter units from the software.

FORMAT
OF [terminator]

EXAMPLE
PRINT #1,"OF;"

DESCRIPTION
The plotter always outputs the following values.

40,40[TERM]

It indicates that 40 plotter units per 1mm exist on both the X axis and the Y axis.
[TERM] is the output terminator for the RS-232C interface. For details, refer to "7.6
Device control commands [ESC].M" in Chapter 7.

"OH" COMMAND

The Output Hard Clip Limits (Maximum Plotting Area) Command

FUNCTION
The OH command is received, the plotter outputs the LL and UR coordinates in integer
plotter units.

FORMAT
OH[terminater]

EXAMPLE
PRINT#1,"OH;"

DESCRIPTION
When the plotter receives the OH command, it outputs the following four coordinates
in ASCII code.

XLL,YLL,XUR,YUR [TERM]

For negative coordinates, the negative symbols are output and the head position zero
and the positive symbol are omitted by the plotter.

The hard clip limits determine the maximum plotting area. The IW command for setting the plotting area, as described below, can further limit the plotting area by establishing window at the desired location within the maximum plotting area.
By using the IW command, the output from the OH command is not influenced.
[TERM] is the output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC].M" in Chapter 7.

<div align="right">(For serial connection only)</div>

"OI" COMMAND

The Output Identification Command

FUNCTION
The OI command outputs the model name of the plotter.

FORMAT
OI [terminator]

EXAMPLE
```
        PRINT #1,"OI;"
        INPUT #1,A$
        PRINT A$
```

DESCRIPTION
By using this command, the model name of the plotter currently connected to the computer can be known by the computer. Before this command is actually used in a program, it is necessary to open a RS-232C file on the computer with the OPEN command.
The DXY-990 outputs "DXY-990" in ASCII code.

<div align="right">(For serial connection only)</div>

"OO" COMMAND

The Output Option Command

FUNCTION
The OO command output 8 option parameters. This command is used to learn the option function which are set on the plotter currently connected and their status.

FORMAT
OO [terminator]

EXAMPLE
PRINT #1,"OO;"

DESCRIPTION
In this command, the following 8 integers, separated by commas, are output to the computer.

```
0,1,0,0,1,0,0,0[TERM]
    |     |_____ Arc, Circle Instuction
    |_____ Pen Change Enable
```

[TERM] is the output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC].M"in Chapter 7.

(For serial connection only)

"OP" COMMAND

The Output P1 and P2 Command

FUNCTION
The OP command allows P1 and P2 setting values to be acquired by a computer.

FORMAT
OP [terminator]

EXAMPLE
        PRINT #1,"OP;"
        INPUT #1,A,B,C,D
        PRINT A,B,C,D

DESCRIPTION
When the plotter receives the OP command, it outputs the following four coordinates in ASCII code.

P1x,P1y,P2x,P2y [TERM]

P1x,P1y,P2x and P2y indicate integer values of plotter coordinate. [TERM] is output terminator for the RS-232C interface. For details, refer to "7.6 Device control command [ESC] .M" in Chapter 7. Since the OP command only allows the coordinate values to be output, it is necessary to enter the external input command for your computer after the OP command so that the values are acquired by the computer.
For example,

INPUT #1,A,B,C,D

will assign the values of P1x, P1y, P2x and P2y to variables A, B, C and D respectively. When the output is completed, bit 1 of the output status byte is cleared. This command permits you to know P1 and P2 coordinates which are manually set and serves to set a window in the area of P1 or P2 or for conversion between user coordinates and plotter coordinates.

(For serial connection only)

"OS" COMMAND

The Output Status Command

FUNCTION
The OS command allows status byte value to be read by the computer.

FORMAT
OS [terminator]

EXAMPLE
PRINT #1,"OS;"

DESCRIPTION
The OS command is used for debugging operations and digitizing applications. No parameter is used with the command. Receiving the OS command, the plotter converts an 8-bit status byte value to the decimal value between 0 and 255, and is ready to output it in the following ASCII code value.

Decimal value of status byte [TERM]

Individual bits of the status byte are defined as follows

Bit value	Bit position	Meaning
1	0	Pen down
2	1	P1 or P2 is changed (cleared by "OP")
4	2	Digitized point can be outputted by the OD command (cleared by "OD")
8	3	Initialized (cleared by "OS")
16	4	(Unused, always 1)
32	5	There is an error (cleared by "OE")
64	6	(Unused, always 0)
128	7	(Unused, always 0)

Table OS-1

After power ON, the status byte is 24 in decimal.
This is because bit 3 and bit 4 (initialized and ready to receive and ready to data) of the status byte are set, thus the sum of 8 and 16 is 24.[TERM] is output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands ESC .M" in Chapter 7.
Before using the command in an actual program, execute the OPEN statement by the direct command from the computer to open a file.

```
PRINT #1,"OS;"
INPUT #1,S
PRINT S
```

"OW" COMMAND

The Output Window Command

FUNCTION
The OW command outputs coordinates of the lower left corner of the window on the plotter the plotter to a computer.

FORMAT
OW [terminator]

EXAMPLE
      PRINT #1,"OW;"
      INPUT #1,A,B,C,D
      PRINT A,B,C,D

DESCRIPTION
This command is used with no parameter. When the plotter receives the command, it outputs plotter coordinates of the lower left corner and upper right corner of the window in ASCII code.
The order of the outputs is as follows.

X1 lower left, Y1 lower left, X2 upper right, Y2 upper right [TERM]

[TERM] is output terminator for the RS-232C interface. For details, refer to "7.6 Device control commands [ESC].M" in Chapter 7. Window size can be known by executing the OW command just after power ON or execution of the DF or IN command, which allows you to determine the setting of DIP switch 1-⑦ and ⑧ (paper size). To know the window size, execute the OW command and read the values by computer.

"PA" COMMAND

The Plot Absolute Command

FUNCTION
PA command sets an absolute coordinate system.
Specified by the X and Y coordinates. The pen moves to the point.

FORMAT
PA X1,Y1 (,X2,Y2,-----) [terminator]
PA [terminator]

EXAMPLE
LPRINT "PA 1000,1000,3000,2000;"
LPRINT "PA;"
LPRINT "PD;PA 1500,1400; PU 2000,2000;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION
The PA command with no parameters sets absolute coordinate system. This makes
parameters of subsequent PD and/or PU commands determined as absolute coor-
dinates. The PA command with parameters sets absolute coordinates and, at the same
time, moves the pen to the point designated by the X, Y coordinates. The pen remains
in a condition before receiving the PA command. Thus, in a pen up conditon, the pen
only moves drawing nothing or, in a pen down condition, it draws.
Any number of sets of parameters X and Y can be used, but if an odd number of
parameters are used, such as only X or Y, every two parameters from the top will be
regarded as a parameter set to plot and the last single parameter will cause an error.

The PA command is used in combination with the pen control commands PU and PD
as shown in example below.

Example (1)

```
100 REM ****SCALE OFF PLOTTER UNITS****
110 LPRINT "IN; SP1;"
120 LPRINT "PA 3000,1500;PD 1000,1500,1000,3500,3000,3500,3000,1500; PU
    3500,1500;"
130 LPRINT "PA; PD 5500,1500,5500,3500,3500,3500,3500,1500; PU;"
140 END
```
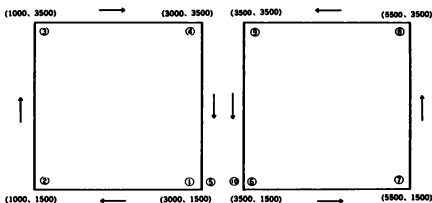

Fig. PA-1

Example (2)

```
150 REM ****SCALE ON USER UNITS****
160 LPRINT "IN; SP1;"
170 LPRINT "SC 0,100,0,100;"
180 LPRINT "PA 30,15; PD 0,15,0,35,30,35,30,15; PU 35,15;"
190 LPRINT "PA; PD 65,15,65,35,35,35,35,15; PU;"
195 END
```
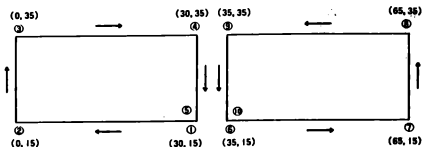
Fig. PA-2

"PU" and "PD" COMMANDS
The Pen Up/Down Commands

FUNCTION
Pen up command PU and pen down command PD raise and lower the pen condition.
With parameters, the pen moves to the point designated by the parameters in a specified pen condition. This allows the pen to draw lines or move to the pen up condition.

FORMAT
PU [terminator]
PD [terminator]
PU X1,Y1 (,X2,Y2,——) [terminator]
PD X1,Y1 (,X2,Y2,——) [terminator]

EXAMPLE
LPRINT "PU 1000,1000;"
LPRINT "PD 1500,2000,1000,500;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION
Without parameters, the pen moves only up or down.
With parameters, the pen moves to the designated point, as the absolute coordinates if the PA command has been entered, in that pen condition.
However, when a point out of the window is designated, the pen moves to the boundary of the window, then moves up.
Two parameters of X and Y make a set, and any number of sets can be used.

"PR" COMMAND

The Plot Relative Command

FUNCTION

PR command set a relative coordinate.
When ΔX and ΔY are specified, the pen is moved by the difference specified by ΔX and ΔY from the current position.

FORMAT

PR ΔX1,ΔY1 (,ΔX2,ΔY2, -----) [terminator]
PR [terminator]

EXAMPLE

LPRINT "PR 1000,5000,−300,700;"
LPRINT "PR; PU 1000,5000; PD −300,700;"
LPRINT "PR;"

PARAMETER RANGE

−32768.0000 to +32767.4999

DESCRIPTION

The PR command with no parameter is used to set a relative coordinate system. This makes parameters of subsequent PD and/or PU commands determined as relative coordinates. The PR command with parameters sets relative coordinates and, at the same time, moves the pen by a designated difference from the current position. The new positions set to as a new original point for the next movement.
If an odd number of parameters of are used, every two parameters from the top will be regarded as a parameter set and the last single parameter will cause an error.
After switching ON the power or execution of either IN or DF command is the same as the execution of the PA command. Therefore, it is necessary to execute the PR command to set X and Y values to relative coordinates. The example shown below uses the PR command to draw a rectangular pattern, same as drawn in the PA command example(1). Each point is given with its X and Y differential coordinate system.
Compare them with the absolute coordinate values in ( ).

Example

```
100 REM ****PR Command****
110 LPRINT "IN;SP1;"
120 LPRINT "PA3000,1500;PD;PR−2000,0,0,2000,2000,0,0,−2000;PU500,0;"
130 LPRINT "PD2000,0,0,2000,−2000,0,0,−2000;PU;"
140 END
```
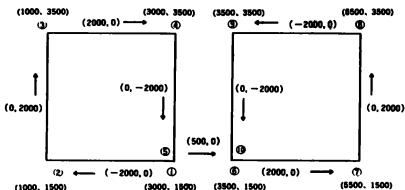
Fig. PR-1

"PS" COMMAND
The Paper Size Instruction

FUNCTION
The PS command changes the paper sizes programmatically between A and B, or A3 and A4 paper sizes.

FORMAT
PS paper size [terminator]

EXAMPLE
PRINT #1,"PS 0;"

PARAMETER RANGE
0 to 127

DESCRIPTION
The parameter in the range of 0 to 3 selects either B or A3, the range of 4 to 127 selects either A or A4. The PS command cannot change from ANSI to ISO.

"PT" COMMAND
The Pen Thickness Command

FUNCTION
Used to specify the shading to suit the pen tip thickness.

FORMAT
PT d [terminator]

EXAMPLE
LPRINT "PT 0.4;"

PARAMETER RANGE
0.1 to 5.0

DEFAULT VALUE
"PT 0.3;"

DESCRIPTION
Parameters are specified in mm. If the pen thickness is not specified, a value of 0.3mm is set.
The PT command is valid only for the pen being just used.
When the SP command is executed, the set value is ignored and the pen thickness is set at the default value of 0.3mm until it is set by the next PT command.

Example

```
100 REM *** SHADING SAMPLE ***
110 LPRINT "SP1;FT 1,0,0;"
120 LPRINT "PT0.3;"
130 LPRINT "RA1000,1000;"
```


(1000, 1000)

Fig. PT-1

"RA" COMMAND

The Shade Rectangle Absolute Command

FUNCTION
Used in conjunction with the FT and PT commands to shade or hatch the inside of rectangle which is specified diagonally with both the current pen position and X, Y coordinates values.

FORMAT
RA X,Y [terminator]

EXAMPLE
LPRINT "RA 2000,2000;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION
Hatches the inside of rectangle which is specified diagonally with the X and Y coordinates. Hatching begins from the current pen position.
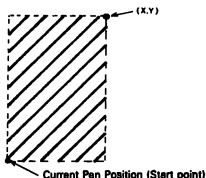
Fig. RA-1

When hatching is completed the pen returns to the start position.
Hatching is performed in accordance with the current FT and PT command settings
(hatching type, shading space, angle).

Example

```
100 REM *** HATCHING SAMPLE ***
110 LPRINT "SP1;FT3,130,45;"
120 LPRINT "PA;PU1000,1000;"
130 LPRINT "RA2000,2000;"
```
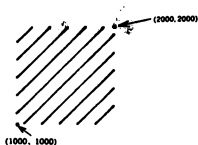

Fig. RA-2

"RO" COMMAND

The Rotate Coordinate System Command

FUNCTION
The RO command rotates coordinate system 90 degrees.

FORMAT
RO rotate angle in degree [terminator]
RO [terminator]

EXAMPLE
LPRINT "RO 90;"
LPRINT "RO;"

DESCRIPTION

The RO command without parameters is equal to the parameter at 0. 0 and 90 are the only values that are accepted as a parameter. When B∕A3 paper size is celected (DIP Switch 1-⑦:off), the X and Y axis rotates 90 degrees in a counterclockwise direction shown in Fig. RO-1. When A∕A4 paper size is selected (DIP Switch 1-⑦:on), the X and Y axis rotate 90 degrees in a clockwise direction shown in Fig. RO-2.

Scaling points P1 and P2 change as the RO command and the IP,IW command are excuted.

In Fig. RO-1, RO-2 at ③, if the RO,IP,IW command without parameter is executed, the plotter enters the default status again.

The IN command can cause the plotters to enter the default status ① from the status ②,③, but the DF command can not.

Pressing theFAST key on the control panel while pressing the ENTER key change ① to the ③ state in Fig. RO-1, RO-2.

A3/B size

Fig.RO-1

A4/A size

Fig.RO-2
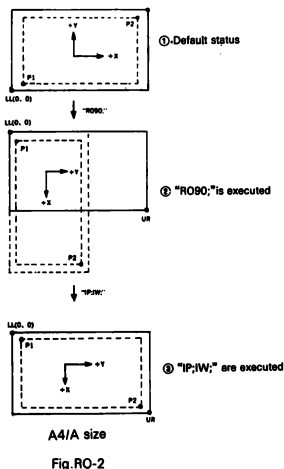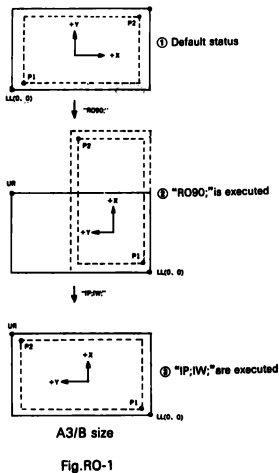
When the coordinate system is rotated, the P1, P2 coordinate values are the values
that are established when the DIP switch 1-⑦, ⑧ sets the paper size and the paper
standard and are as follows.

Paper size	P1x, P1y	P2x, P2y
A3(ISO)	607, 797	10607, 15997
A4(ISO)	0, 610	7200, 10610
B(ANSI)	283, 934	10283, 16134
A(ANSI)	154, 244	7354, 10244

Table RÓ-1

(Note) If the coordinate axis is rotated by the RO command, the X,Y coordinate display
shows the same display as prior to the rotation.

"RR" COMMAND
The Shade Rectangle Relative Command

FUNCTION
Used to shade or hatch the inside of a rectangle which is specified diagonally with both
current pen position and X, Y increments.

FORMAT
RR ΔX,ΔY [terminator]

EXAMPLE
LPRINT "RR 2000,2000;"

PARAMETER RANGE
−32768.0000 to +32767.4999

DESCRIPTION
Hatches a rectangle specified with the X and Y increments. Hatching begins from the
current pen position.

(X increment, Y increment)

Hatches within this rectangle

Current pen position (start point)
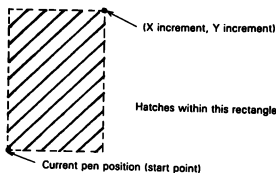
Fig. RR-1

-. Hatching is performed in accordance with the current FT and PT command settings (hatching type, shading space, angle).

Example

```
100 REM ***HATCHING SAMPLE ***
110 LPRINT "SP1;FT4,100,90;"
120 LPRINT "PA;PU2000,2000;"
130 LPRINT "RR1000,1000;"
```


Fig. RR-2

"SA" COMMAND
The Select Alternate Character Set Command

FUNCTION
The SA command designates the alternate character set to be used for printing.

FORMAT
SA [terminator]

EXAMPLE
LPRINT "SA;"

DESCRIPTION
After the SA command, a character set designated by the CA command is used for printing. This is effective until the standard character set is selected by the SS command or ⎡SI⎤ (CHR$(15)) resetting by the DF or IN command. In print mode, the alternate character set can be selected by ⎡SO⎤ (CHR$(14)).
This command requires no parameter. For the relation to the CS, CA and SS commands refer to "5. 5 Selection of Character Set" in Chapter 5.

"SC" COMMAND
The Scale Command

FUNCTION
The SC command sets user coordinates or returns user coordinates to plotter coordinates.

FORMAT
SC Xmin,Xmax,Ymin,Ymax [terminator]
SC [terminator]

EXAMPLE
LPRINT "SC 0,10,0,10;"
LPRINT "SC;"

PARAMETER RANGE
−32768.0000 and 32767.9999

DEFAULT VALUE
Depends on the DIP switch setting of the paper size mode.

DESCRIPTION
The SC command with parameters sets the user coordinates of P1 to Xmin and Ymin
and Ymax and Ymax. Each parameter must be a real number between −32768 and
32767. User coordinates once set are effective until they are rescaled by another SC
command or returned to the plotter coordinates by the SC command with no param-
eters. While the command is effective, all plot command parameters are regarded as
user coordinates. The SC command with no parameters also cancels the IP setting. Then
the command parameters are the same as plotter coordinates and the plotter returns to
an unscaled condition.
∗Note that the order of parameters is different from other commands.

"SI" COMMAND

The Absolute Character Size Command

FUNCTION
Designates size of characters or symbols in centimeter (cm).

FORMAT
SI character width, height [terminator]
SI [terminator]

EXAMPLE
LPRINT "SI 10,10;"
LPRINT "SI;"

PARAMETER RANGE
−128.0000 to +127.9999 (cm)

DEFAULT VALUE
"SI 0.29,0.38;" (B/A3)
"SI 0.19,0.27;" (A/A4)

DESCRIPTION
The SI command designates absolute character size by two parameters, character
width and height. A character size designated by the SI command is unchanged by
reduction or enlargement using the IP, SC, or IW command or manual control. The SI
command with no parameters sets the default status. A single or more parameters will
cause an error and the character size will be unchanged.

"SL" COMMAND
The Character Slant Command

FUNCTION
SL command designates slant of printed characters or symbols

FORMAT
SL tanθ [terminator]
SL [terminator]

EXAMPLE
LPRINT "SL 1;"
LPRINT "SL;"

PARAMETER RANGE
−128.0000 to +127.9999 (cm)

DEFAULT VALUE
"SL 0;"

RELATED COMMANDS
IN,DF

DESCRIPTION
A parameter designates tanθ to the vertical line as shown. If two or more parameters are used, other parameters than the first one will be ignored. The SL command without parameters defaults to slant condition. The parameter range is from −128.0000 to +127.9999. However, for easy reading, it is recommended to use a parameter within ±0.4 for default size characters or ±0.8 for enlarged. The SL command remains in effect until IN,DF or new SL command is received.
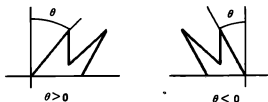
Fig. SL-1

"SM" COMMAND

The Symbol Mode Command

FUNCTION
The SM command draws a character or a symbol centering a point designated by the
PA and PR command.

FORMAT
SM character or symbol [terminator]
SM [terminator]

EXAMPLE
LPRINT "SMK;"
LPRINT "SM;"

RELATED COMMANDS
SI,SR,SL,DI,DR

DEFAULT VALUE
"SM;" (no symbol mode)

DESCRIPTION
Parameter is limited to a single, printable character or symbol. After a character or symbol is designated by the SM command, it is printed centering a point designated by the
PA or PR command. Once designated, it is effective until another character is
designated (Symbol mode is not released) to symbol mode is released. Symbol mode is
released by the SM command with no parameter.
The IN or DF command also releases the symbol mode.
A designated character is affected by a command that the size (SI or SR), slant (SL) or
direction (DI or DR).
A semicolon (;) cannot be designated because it is regarded as a terminator. Also a
space or control code cannot be designated.

The example shown below is to draw characters or symbols on curves.

Example

```
100 REM **** "SM"Command****
110 LPRINT "IN;SP1;PA0,0;"
120 LPRINT "PD0,3000,3000,3000,3000,0,0,0;PU;"
130 FOR I=1 TO 3
140  READ S$
150  LPRINT "SM";S$;";"
160  X=500
170  FOR L = 1 TO 4
180   READ Y
190   LPRINT "PA";X;",";Y;";PD;"
200   X=X+500
210  NEXT L
220  LPRINT "PU "
230 NEXT I
```

```
240 LPRINT "SM;PA0,0;"
250 END
260 DATA *,500,1300,2000,2700
270 DATA R,1500,1700,1300,1000
280 DATA G,2800,2000,1000,400
```
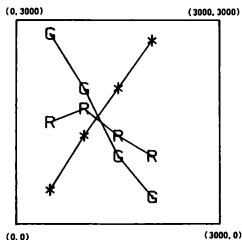

Fig. SM-1

"SP" COMMAND

The Select Pen Command

FUNCTION
SP command selects or stores one of the eight pens.

FORMAT
SP pen number [terminator]
SP [terminator]

EXAMPLE
LPRINT "SP 1;"

PARAMETER RANGE
0 to 8

DEFAULT VALUE
"SP 0;"

DESCRIPTION
Selects one of No.1 to No.8 pens according to the parameter. The SP command with
no parameter or 0 returns a pen to the pen stock and moves to the lower left position.
After a pen is taken up, the system returns to the position before executing the SP com-
mand. If a same pen number as the pen carriage is designated, the pen carriage will not
move.

"SR" COMMAND

The Relative Character Size Command

FUNCTION
Designates size of characters or symbols in percentage (%) to the distance in X- and Y-directions between scaling point P1 and P2.

FORMAT
SR character width, height [terminator]
SR [terminator]

EXAMPLE
LPRINT "SR 2.5,3.5;"
LPRINT "SR;"

PARAMETER RANGE
−128.0000 to +127.9999 (%)

DEFAULT VALUE
"SR 0.75,1.5;"

RELATED COMMANDS
IP,SC,IW

DESCRIPTION
The SR command is to designate relative character size in which character size varies with the distance between P1 and P2. The command with no parameters sets the default status, width to 0.75 and height to 1.5. A single or three or more parameters will cause an error and the command will not be executed.

$$\text{Character width} = (P2x - P1x) \times \frac{\text{width parameter}}{100}$$

$$\text{Character height} = (P2y - P1y) \times \frac{\text{height parameter}}{100}$$
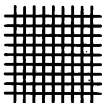
"SS" COMMAND

The Select Standard Character Set Command

FUNCTION
The SS command designates the standard character set to be used for printing.

FORMAT
SS [terminator]

EXAMPLE
LPRINT "SS;"

DESCRIPTION
·After the SS command, a character set designated by the CS command is used for prin-
ting. This is effective until an alternate character set is selected by the SA command or
[SO] (CHR$(14)) or resetting by the DF or IN command.
In print mode, the standard character set can be selected by [SI] (CHR$(15)). This
allows a text composed of English and German to be printed using only a single LB
command, eliminating the need of dividing the LB command to execute the SS
command. This command requires no parameter. For the relation to the CS. ·
CA and SA commands refer to "5.5 Selection of Character Set" in Chapter 5.

"TL" COMMAND

The Tick Length Command

FUNCTION
The TL command designates tick length in percentage (%) of the distance in X and Y
directions between scaling points P1 and P2.

FORMAT
TL tick length in positive direction (,tick length in negative direction) [terminator]
TL [terminator]

EXAMPLE
LPRINT "TL 10,25;"
LPRINT "TL;"

PARAMETER RANGE
−128.0000 to +127.9999

DEFAULT VALUE
"TL 0.5,0.5;"

DESCRIPTION
Positive tick refers to up direction on the X axis and right direction on the Y axis, and
negative tick refers to down direction on the X axis and left direction on the Y aixs.

positive direction   negative direction
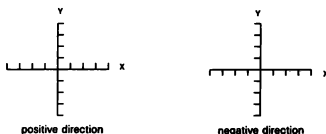
Fig. TL−1

A parameter value of tick length for the XT command is a percentage of P2y−P1y, and for the YT command a percentage of P2x−P1x. The parameter range is from −128.0000 to +127.9999. 0 designates no tick.

A parameter of 100 draws a tick of a length between points P1 and P2 in X and Y directions. Parameter 100 is used to delimit a table rather than for a tick.

Tick length is a portion of length in X and Y direction determined by point P1 and P2. Therefore, note that the length of X tick is different from that of Y tick when an area set by points P1 and P2 is not a square. When initialized or the TL command with no parameter is executed, it is automatically set to 0.5% of the length between point P1 and P2 in X and Y direction. Tick length in negative direction is set to 0 if it is not designated.

The TL command is effective until another TL command is executed or IN or DF command is executed.

Use a positive parameter in principle, because a negative parameter designates a tick length in reverse direction.

A parameter out of the specified range will cause an error when the XT or YT command is executed.

"UC" COMMAND
The User Defined Character Command

FUNCTION
The UC command is used to print characters which are not included in the character sets.

FORAMAT
UC (pen control value,)△X1, △Y1, (pen control value,)······(△Xn, △Yn) [terminator]
UC [terminator]

EXAMPLE
LPRINT "UC −99,3,9,99,4,5,9,3;"
LPRINT "UC;"

PARAMETER RANGE
−128.0000 to +127.9999

DESCRIPTION
The UC command uses three types of parameters, pen control value, X differential, and Y differential.

Pen control value designates a pen up/down condition, −99 or less for a pen up, and 99 or more for a pen down condition. It is recommended to use −99 and 99. The pen always goes up when the plotter receives the UC command and, therefore, a pen down parameter should be placed in the UC command in order to make a point. After the UC command is completed, the pen goes up, moves to the left lower corner of the next right character cell, then returns to a pen condition before the execution of the UC command.

X or Y differential designates a horizontal or vertical pen movement in grid unit. X and Y differentials should be greater than −99 and smaller than 99, and a decimal fraction can be used.

A character cell is divided horizontally into 6 sections and vertically into 16 sections to designates pen movement. (See Fig.UC-1)

An ordinary character is printed within the area surrounded by the dottet lines, horizon-

tal 4 sections × vertical 8 sections. A character defined within the area has a normal character size. A character to be defined by the UC command is not required to be within a character cell. However, since the original point of a character is moved only by a character cell after printing the PA, PR or CP command should be to move the pen out of the defined area when the character to be printed is not within a single character cell. Otherwise, the next character will overlap the printed character.

See Fig. UC−2. This is to draw an arrow mark, an example of the UC command. The original point of the character after executing the UC command is (6,0), and the next character will overlap the end of the arrow if the next character is printed as it is. Then, "CP1,0;" must be executed to move the original point to (12,0). For a UC command with no parameters specified, the pen moves to the starting position in the previously generated LB command.

Fig. UC−1

Original point (6,0) after executing UC command
"UC 0, 2, 99, 0, 4, 6, 0, 0, 2, 3, −4, −3, −4, 0, 2, −6, 0;"

Fig. UC−2

"VS" COMMAND

The Velocity Select Command

FUNCTION
Sets the pen speed during plotting.

FORMAT
VS pen speed [terminator]
VS [terminator]

EXAMPLE
LPRINT "VS 10;"
LPRINT "VS;"

PARAMETER RANGE
0 TO 127.9999

DEFAULT VALUE
"VS 30;"

DESCRIPTION
The VS command with no parameter set the pen speed to the initial value, 30 cm/sec.
The parameter range is 0 to 127.4999. A parameter of less than 1 sets the speed to 1
cm/sec, or more than 30 sets to 30 cm/sec.

"WG" COMMAND

The Shade Wedge Command

FUNTION
Used to shade or hatch the inside of the wedge centered at the current pen position.

FORMAT
WG r,θ1,θc(,θd) [terminator]

EXAMPLE
LPRINT "WG 1000,90,180,5;"

PARAMETER RANGE
r : Radius −32768.0000 to +32767.4999
θ1: Start angle −32768.0000°to +32767.4999°
θc: Center angle −32768.0000°to +32767.4999°
θd: Resolution −120°to +120°
   (default value : 5°)

RELATED COMMANDES
FT, PT, EW

DESCRIPTION

Hatching type, spacing, and angle are as specified with the FT and PT commands. As the base point differs with the sign of the radius parameter, care is required with its specification. The angle relative to the base point differs according to the sign of the start and center angle parameters.

The drawing direction changes in accordance with the sign of the parameter.

Resolution specified the smoothness of circular arc of the wedge. The parameter is specified as an angle(°). The total number of chords par arc is limited to 90, For example, when $\theta c=360°$ and $\theta d=0°$ Resolution θd is set 4°. If resolution is not specified, 5° is set. Specified θd is adjusted into positive numbers to divide θc equally.

The pen returns to the start position after drawing is completed.
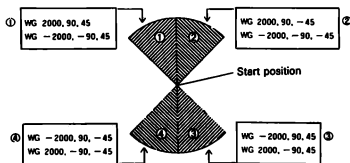
Fig. WG-1

[Example]

```
100  REM***  Wedge HATCHING***
110  LPRINT  "SP1;PA;PU2000,5000;"
120  LPRINT  "FT3,40,0;"  .
130  LPRINT  "WG2000,90,45;"
140  LPRINT  "FT3,40,45;"
150  LPRINT  "WG2000,90,-45;"
160  LPRINT  "FT3,40,90;"
170  LPRINT  "WG-2000,90,-45;"
180  LPRINT  "FT3,40,135;"
190  LPRINT  "WG-2000,90,45;"
```


Fig. WG-2

"XT" and "YT" COMMANDS
The Tick Commands

FUNCTION
The XT command prints a tick of a length designated by the TL command on the X axis and YT command prints it on the Y axis.

FORMAT
XT [termintor]
YT [terminator]

EXAMPLE
LPRINT"XT;"
LPRINT"YT;"

DESCRIPTION
No parameter is required. This command prints a tick based on the current pen position, regardless of pen up/down condition. The tick length can be changed by the TL command. The default value of X axis tick is 0.5%of (P2y − P1y) in both positive and negative directions, and that of Y axis tick is 0.5%of (P2x − P1x).
Examples of the XT command are shown below. In Example 1, the tick is drawn while drawing the axis.
In Example 2, the axis is drawn, then the tick.

(Example 1)
```
100   REM****"XT"Command NO. 1 ****
110   LPRINT"IN;SP2;PA2000,500;PD;XT;"
120   FOR I=1 TO 10
130   LPRINT "PR2000,0;XT;"
140   NEXT I
150   LPRINT "PU;SP0;"
```
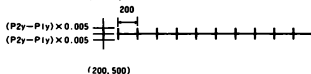

Fig.XTYT−1

(Example 2)
```
200   REM****"XT"Command NO.2****
210   LPRINT"IN;SP2;PA2000,500;PD;"
220   LPRINT"PR2000,0;XT;PU;"
230   FOR I=1TO 10
240   LPRINT "PR−200,0;XT;"
250   NEXT I
260   LPRINT"SP0;"
```
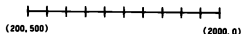

Fig.XTYT-2

7.RS-232C Interface

In this chapter, the character code (ASCII Code) uses a decimal scale, and BASIC language CHR$(character code) is used, witch provides characters corresponding to each character code.
Especially in the case of the control character, ESC (CHR$(27)) or ESC is used.

In the explanation, the example of BASIC language are typical formats in BASIC Please change them according to the computer being used.

PRINT #1, INPUT #1, indicates the INPUT/OUTPUT of RS-232C. In this case, the file should be opened in advance.

7.1 Hardware Handshake

The DXY-990 supports a function to switch DTR ON/OFFaccording to the remaining capacity of the buffer.
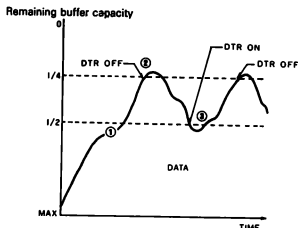
Fig. 7-1

[Setting]
Set hardware handshake ON by the power ON default, or the ESC .@ command.
                        PRINT #1,CHR$(27);"@;1:";
[Operation]
The DTR signal differs according to the following conditions.
① When 1/4 or more of the buffer capacity remains   DTR:ON   (+12V)
② When 1/4 or less of the buffer capacity remains   DTR:OFF   (−12V)
③ When remaining buffer capacity increases to 1/2 or moreDTR:ON   (+12V)

Hardware handshake is possible if the computer supports a function to halt data transmission when input is LOW at the CTS, DSR, or DCD terminals.

[Connection example] IBM-PC / APPLE II, lle (DTE type)
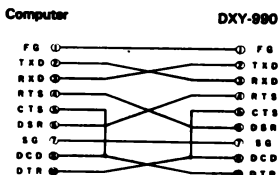
Computer   DXY-990

Fig. 7-2

- DXY-990 buffer capacity : Max 1K byte

7.2 Software Handshake

The DXY-990 supports a function to output buffer status to the computer. The use of this function enables the sending of data while checking the remaining buffer capacity with software.

Software handshake example (for IBM PC)

```
100 ' DXY-990 RS-232C DEVICE CONTROL COMMAND
110 ' SAPLE PROGRAM FOR SOFTWARE HANDSHAKE
120  OPEN"COM1:1200,E,7,1,CS65535" AS#1
130  PRINT #1,CHR$(27),".M100,,,13 ".
140 ' MAIN PROGRAM


        GOSUB 1000                              Main program to plot



        GOSUB 1000

        END
1000 ' SUBROUTINE BUFFER CHECK
1010  PRINT #1,CHR$(27);".B"
1020  INPUT #1,B
1030  PRINT "Buffer space :";B
1040  IF B>=1500 THEN RETURN
1050  GOTO 1010
```

Main program to plot

Line 120 : Alter this line to suit the file opening commands for your computer.
Line 130 : Set to suit your computer.

Line 1000 :
    Checks the remaining buffer capacity and waits for transmission if
    1/2 (512 bytes) or less of the buffer capacity remains.
Line 1050 :

Line 130 sets a delay time of 100msec between reception of an output request from
the computer and the DXY-990 response to this request. The terminator for the output
data is set as character code 13 CR
Line 1010 is an output command for DXY-990 to output its remaining buffer capacity.
These commands are termed device control commands. See the section on device con-
trol commands for details.
In this example, the remaining buffer capacity is checked in lines 1000 ~ 1050 and
data transmission adjusted. This checking requires the use of the GOSUB 1000 at
various locations within the main program.
• Particular care must be taken in this case to ensure that data sent continuously does
  not exceed the buffer capacity.

7.3 Xon/Xoff Handshake

With the Xon/Xoff handshake mode, the plotter sends to the computer Xoff character
when the remaining buffer capacity becomes the designated value or less, and Xon
character when it becomes the another value or more.

```
100 ' DXY-990 RS-232C DEVICE CONTROL COMMAND
110 ' SAMPLE PROGRAM FOR Xon/Xoff HANDSHAKE
120 OPEN "COM1:1200,E,7,1,CS65535"AS #1
130 ON COM(1) GOSUB 1000
140 PRINT #1,CHR$(27); ".M0;0;0;13;0;0:";
150 PRINT #1,CHR$(27); ".I256;0;17:";
160 PRINT #1,CHR$(27); ".N;19:";
170 PRINT #1,CHR$(27); ".@;0:";
180 COM(1) ON
190 ' MAIN PROGRAM
        |
        |                                            ⎤
        |                                            ⎬  Main program to plot
      END                                            ⎦

1000 ' INTERRUPT Xon/Xoff
1010 A$=INPUT$(1,#1)
1020 If A$=CHR$(19) THEN PRINT "Xoff "
1030 COM(1) OFF
1040 PRINT "wait "
1050 A$=INPUT$(1,#1)
1060 IF A$=CHR$(17) THEN PRINT "Xon ":COM(1) ON:RETURN
1070 PRINT "ILLEGAL Xon "
1080 RETURN
```

Main program to plot

Line 120 : Alter this line to suit the file opening commands for your computer.
Line 140 ⎤
         ⎬ Setting for Xon/Xoff handshake.
Line 170 ⎦
Line 1000 ⎤
          ⎬ Process the interrupt signal from the plotter.
Line 1080 ⎦

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Setting with lines 140 ~ 170 results in the following plotter operation.
① Character code 19 is output as Xoff when the remaining buffer capacity becomes 256 bytes or less.
② Character code 17 is output as Xon when the remaining buffer capacity becomes 1/2 or more of the total.
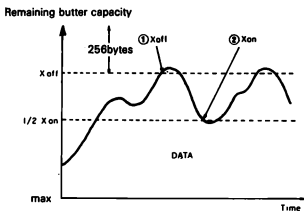
Fig. 7-3

As these signals are output as an interrupt during computer operation, the computer must support a function to receive the interrupt.
When the interrupt is received program execution jumps to lines 1000 ~ 1080; if the interrupt signal is Xoff the computer waits until Xon is received.

7.4 ENQ/ACK Handshake

With the ENQ/ACK handshake mode, the computer sends the ENQ character to enquire the plotter about the remaining buffer capacity. To the enquire, the plotter returns the ACK character if the buffer space is available.

```
100'  DXY-990 RS-232C DEVICE CONTROL COMMAND
110'  SAMPLE PROGRAM FOR ENQ/ACK HANDSHAKE
120   OPEN "COM1:1200,E,7,1,CS65535" AS #1
      :OPEN "DATA1" FOR INPUT AS #2
130   ON COM(1) GOSUB 1000
140   ON COM(1)ON
150   PRINT #1,CHR$(27); ".@;0:";
160'  SET HANDSHAKE MODE ENQ/ACK
170   PRINT #1, CHR$(27);".M100;00;00;13;00;00;";
180'  ENQ charaxter = CHR$(7)
190'  ACK character = CHR$(6)
200   PRINT #1, CHR$(27);".H256;7;6;";
210'  MAIN PROGRAM
220   PRINT "•••ENQ ":PRINT #1,CHR$(7)
230'  Current Job
```

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```
                    |
                    |
              Main program        }  All job but plotting by DATA 1.
                    |
                    |
                  END           ┘
      1000   'BLOCK TRANSFER
      1010   PRINT"ACK "ACK$=INPUT$(1,#1)
      1020   IF ACK$<>CHR$(6) THEN RETURN
      1030    FOR I=1 TO 256
      1040    IF EOF(2) THEN GOTO 1100
      1050    INPUT #2,A$
      1060    PRINT #1,A$;
      1070    PRINT A$;
      1080    NEXT I
      1090   PRINT "•••ENQ "PRINT #,CHR$(7);:RETURN
      1100   PRINT "DATA END ": RETURN
```

Line 120 : Opens two files. Alter this line to suit the file opening commands for
              your computer.
Line 150 :
              Setting for ENQ/ACK handshake.
Line 200 :
Line 220 : Sends the ENQ signal to the plotter.
Line 1010 :
              Main program exited with reception of the ACK signal from the plot-
              ter, and 256 bytes of data then sent to the plotter.
Line 1100 :

The setting in lines 150~200 is such that character code 7 is sent to the plotter as the
ENQ signal, and the plotter sends character code 6 to the computer as the ACK signal if
more than 256 bytes or more of buffer capacity remain.

This program checks the plotter status during execution of main program and outputs
one block of data (256 bytes of plotter data in this case•) with interrupt operation if suf-
ficient buffer space remains. If insufficient buffer space remains, or there is no output
data, the main program is processed. The use of these four types of handshaking
prevents data from being lost or the use of ENQ/ACK handshaking utilizes available
space time at computer for effective jobs other than plotting.

* This assumes that data sent to the plotter is written into file #2 DATA 1.
  Execution of the following writes the file DATA.1 onto the disk.

```
      10   OPEN "A:DATA1"FOR OUTPUT AS #1 ⎫
      20   PRINT #1,   "        "          |
                   |                       ⎬  Plotter data
                   |                       |
                   |                       |
    1000   END                           ⎭
```

7.5 Monitor Mode

The previous sections have described connection of the DXY-990 and the computer. This section describes the use of the DXY-990 in the monitor mode to allow connection of the computer, DXY-990, and a terminal or printer using one RS-232C port. An example of a cable used in the monitor mode is shown below.

```
Computer                              Terminal or printer
   F G                                     I      F G
   T X D  ──┐                        ┌── 2      T X D
  ·R X D  ─┐│                        │┌─ 3      R X D
   R T S ─┐││                        ││┌ 4      R T S
   C T S  ││└──────────────────────┘││ 5      C T S
   D S R  │└────────────────────────┘│ 6      D S R
   S G   ─┼─────────────────────────── 7      S G
   D C D  │                            8      D C D
   D T R  └───────────────────────── 20      D T R
Plotter
   F G   I ──┐
   T X D 2 ──┘
   R X D 3 ──┐
   S G   7 ──┘
 S.TXDI4 ──
 S.RXDI6 ─────────────────────────────
```
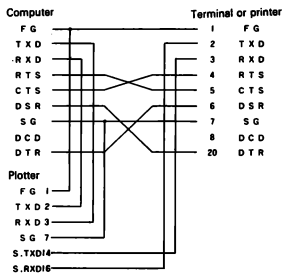
Fig. 7-4

[Monitor mode setting]
Set switch ON #6 on the DIP switch 1 (SW1) in the DXY-990 (Y mode). When power is switched ON in this mode, the DXY-990 is set in the monitor mode and all data is ignored until $\boxed{\text{ESC}}$ .Y or $\boxed{\text{ESC}}$.(is received (program ON).

Following input of $\boxed{\text{ESC}}$ .Y, the following modes may be selected by inputting the $\boxed{\text{ESC}}$. @ command.

	DTR status	Mode	Monitor status	Response	
				Computer	Terminal
0	High	Mode 0	Monitor mode cleared	Response to all commands	No response
1	Hardware handshake				
4	High				
5	Hardware handshake				
8	High	Mode1	Monitor mode		Mode1
9	Hardware handshake				
12	High	Mode2			Mode2
13	Hardware handshake				

Table 7-1

DTR
    High ····Hardware handshake always cleared in the high status.
    Hardware handshake···Hardware handshake status.
Mode
    1··· The plotter stores data from the computer into the plotter buffer.
        When the plotter executes the data stored in the buffer, the data being ex-
        ecuted are echoed back to the terminal, except device control commands.
    2··· All data received by the plotter from the computer is echoed back to the ter-
        minal.

When [ESC].Z or [ESC].) is received the plotter ignores all following commands.
The ignored data is echoed back to the terminal (program OFF).
* When the DXY-990 is located between the computer and the terminal the data is
    sent via the DXY-990 processor. The DXY-990 power supply, therefore, must be
    ON for communication between the computer and terminal.
* While the plotter is sending the data, the data from the terminal is not sent to the
    computer.

7.6 Device Control Commands

The following commands are valid only when the serial interface (RS-232C) is connected.

HANDSHAKE MODE COMMANDS

ESC .M
ESC . B
ESC . I
ESC .H
ESC .N

STATUS COMMANDS

ESC .E
ESC .L
ESC .O

ABORT COMMANDS

ESC .J
ESC .K
ESC .R

MONITOR MODE COMMANDS

ESC .Y
ESC .Z
ESC .@

HANDSHAKE MODE COMMANDS

"ESC.M" COMMAND

● **Format**
  [ESC]. M P1;P2;P3;P4;P5;P6:

● **Explanation**
  <P1>
  Determines the delay time between when the computer requires output from the plotter and the plotter begins output.
  Program example : [ESC]. M100:
  This sets the delay time to 100msec. The parameter range is 0 to 32000.

  <P2>
  Sets the trigger character. The plotter only sends data after this character set in P2 is received.
  Program example : [ESC]. M;13:
  P1 is initially set to 0, the trigger character code is 13([CR].carriage return).If, for example, [ESC]. B is sent to the plotter, reception by the plotter of the next carriage return (CR) will result in output of the remaining buffer capacity to the computer.

  <P3>
  Sets the echo-back terminator. When the computer echoes back again the data sent from the plotter to the plotter, the plotter ignores all data until the terminator character set in P3 is received.
  Program example : [ESC]. M;;10:
  P1 and P2 are set at the initial values, and the line-feed code (10) is used as the echo-back terminator so that the computer must output data to the plotter after echo-back.

  <P4, P5>
  Sets the output terminator. Outputs as the terminator for data output by the plotter.
  Program example : ① [ESC]. M;;;13:
  　　　　　　　　　② [ESC]. M;;;13; 10;0:
  In the example ①, the carriage return code (13:CR) is output as the terminator in the example ②, the carriage return (13:CR) and line feed (10:LF) codes are output P6 must be set to 0 in this case.

  <P6>
  The plotter sets the character output before data is sent to the computer.
  Program example : [ESC].M;;;13;0;33: .
  "" is output to the computer before the data. P5 must be set to 0 in this case.

"ESC.B". COMMAND

● **Format1** [ESC]. B

● **Explanation**
Outputs the current number of empty buffers to the computer. As this command is used by the computer to check the number of empty buffers, data equal to or less then this value may be output to the plotter. This command may be used to prevent buffer overflow.

"ESC.I" COMMAND

● **Format** [ESC]. I P1;P2;P3;……;P12:

● **Explanation**
Used in conjunction with the [ESC]. N command when Xon/Xoff handshake is used.
<P1>
Sets the residual quantity of the buffer.
When the number of empty buffers is less than the number set in P1, the plotter outputs the Xoff character.
Program example : [ESC]. I 100;:17: [ESC]. N;19:
When the numbers of empty buffer become by 100 bytes the Xoff character is output.
The parameter range is 10 to 256.

<P2>
Always set to 0 in the case of Xon/Xoff.
Program example : [ESC]. I;;17: [ESC]. N;19:
                   [ESC]. I;0;17: [ESC]. N;19:
P1 is set to the initial value of 80 bytes, the Xon character is DC1 (17), and the Xoff character is DC3 (19).

<P3 to P12>
Sets the Xon character (see P2). A string of up to 10 characters may be set.
The individual character codes are delineated by a semicolon.

"ESC∶H" COMMAND

● **Format** ⊡ESC⊡. H P1;P2;P3;⋯⋯;P12:

● **Explanation**

Sets ENQ/ACK handshake. When the computer sends the ENQ character to the plotter, the ACK character is output only when the number of empty buffers is available more than the value set in P1. When the ACK character is received by the computer, data equal to the number of bytes set in P1 is output in one block.

<P1>
Sets the number of bytes in the data blocks sent to the plotter from the computer.
When the plotter receives the ENQ character, the ACK character is output if the number of empty buffers is more than the value set in P1.
Program example : ⊡ESC⊡. H 128;5;6:
In this example each data block has a size of 128 bytes, the ENQ character is ⊡ENQ⊡ [CHR$(5)], and the ACK character is ⊡ACK⊡[CHR$(6)].
The parameter range is 0 to 256.

<P2>
Sets the ENQ character. When the plotter receives this P2 code, the ACK character is output if the number of empty buffers set in P1 is available, and then waits for data from the computer.

<P3 to P12>
Sets the ACK character A string of up to 10 characters may be set (see ⊡ESC⊡. l).

"ESC.N" COMMAND

● **Format** ⊡ESC⊡. N P1;P2;⋯⋯;P11:

● **Explanation**

Output by the plotter. Sets the delay time between characters. Also sets the X off character.

<P1>
The range is 0 to 65536 msec. Sets the interval time between characters in the character string output by the plotter.
Program example : ⊡ESC⊡. N10:
When ⊡ESC⊡. L is sent to the plotter, the plotter outputs "1024⊡CR⊡". In this case each of the terminators and characters is sent to the computer at 10 msec. intervals (see ESC . M).

<P2 to P11>
Sets the Xoff character. A string of up to 10 characters as maximum may be set (see ⊡ESC⊡. l)

STATUS COMMANDS

"ESC.E" COMMAND

● **Format** $\boxed{\text{ESC}}$. E

● **Explanation**
When the plotter receives this command, it outputs the error code for RS-232C and clears the error display simultaneously.

Error codes
- 0 An I/O error has not occurred.
- 10 While an output request is executed, another command requesting output will not be received, but only the first command is valid.
- 11 A device control command error has occurred.
- 12 When a device control command parameter is unsuitable, the parameter causing the error is initialized.
- 13 When a parameter has overflowed.
- 14 When too many parameters are input, or parameters are not delineated by ":".
- 15 When a framing error, parity error, or overrun error has occurred during reception of data.
- 16 When the input buffer has overflowed. In this case normal drawing operation is impossible.

"ESC.L" COMMAND

● **Format** $\boxed{\text{ESC}}$ L

● **Explanation**
When the plotter receives the command, it outputs the size of buffer to the computer. In case of 1K bytes buffer, which is standard, 1024 is normally output.

"ESC.O" COMMAND

● **Format** $\boxed{\text{ESC}}$. O

● **Explanation**
Outputs the plotter status as a code.

Code	Buffer capacity status
0	Buffer is not empty
8	Buffer is empty
16	Buffer is not empty, and Plotter is on standby *
24	Buffer is empty, and Plotter is on standby *

* The PAUSE switch is ON.

Table 7-2

ABORT COMMANDS

"ESC.J" COMMAND

● **Format** [ESC]. J

● **Explanation**
Aborts the device control command currently being executed.

"ESC.K" COMMAND

● **Format** [ESC]. K

● **Explanation**
Aborts plotting operation and clears all data in the buffer.

"ESC.R" COMMAND

● **Format** [ESC]. R

● **Explanation**
Initializes all the handshake command parameters.

Default
values [ESC]. M:
        [ESC]. M0;0;0;13;0;0:

        [ESC]. I:
        [ESC]. I 80;0;0;·········0:

        [ESC]. H:
        [ESC]. H 80;0;0;·········0:

        [ESC]. N:
        [ESC]. N0;0:

        [ESC]. @:   (Set to the hardware handshake mode)
        [ESC]. @ 0;1:

MONITOR MODE COMMANDS

The DXY-990 supports a function to output data sent from the computer to a printer or terminal.
The cable used in this case is shown in Fig. 7-2
The commands explained below are valid only when No. 4 on the plotter DIP switch 2 is set to ON (ie the Y mode).

The plotter monitors the terminal output after the ESC.Y command was input. If the terminal outputs over 150ms BREAK signal, the plotter will not take in any data after that as when the ESC.Z command is input.
The BREAK signal is output to the computer simultaneously as to the plotter.

"ESC.Y" COMMAND

● Format   ESC . Y or ESC . (

● Explanation
After plotter power is ON, all data is ignored until this command is received.
The ignored data is output to the terminal via pin No.14 of the 25-pin Connector.

"ESC.Z" COMMAND

● Format   ESC . Z or ESC .)

● Explanation
When this command is received, all the following data sent from the computer is ignored.

"ESC.@" COMMAND

● Format   ESC . @ P1;P2:
● Explanation
<P1>
Specifies the I/O buffer size. The parameter range is 0 ~ 9999. The value larger than the default value 1024 (1K bytes) results in the default value.

<P2>
Sets the DTR signal (25pin connector, pin No.20) control and the monitor mode.

● Parameter bits
Example 1 : ESC . @;0:
Keep monitor mode OFF and DTR signal always ON. In this case, data following the ESC . Y command is received by the plotter only and not output to the terminal. Hardware handshake is not performed.

Example 2 : ESC . @;8:
Set monitor mode ON; and mode 0. In mode 0, the data stored in the plotter buffer is output to the terminal (or printer).

Example 3 : ESC . @;12:
Set monitor mode ON, and mode 1. In mode 1, the data received by the plotter from the computer is output to the terminal (or printer).

8. Appendix

8.1 Interface Operation Manual

8.1.1 Parallel Connection

The input terminal of DXY-990 is compatible with Centronics Standard and can be connected to printer ports of most computers, using a printer cable. For method of connection with various computers refer to chapter 4 "Connections."
The DXY-990 specification is as follows.

(a) Connector
Use DDK57-30360, AMP552235-1 or equivalent.
The plotter is provided with HRS RCIO-36R3-LW or equiralent.

NC	36	18	HIGH※※
NC	35	17	GND
NC	34	16	GND
GND	33	15	NC
HIGH※	32	14	NC
NC	31	13	HIGH※
	30	12	GND
	29	11	BUSY
	28	10	ACK
	27	9	D7
	26	8	D6
GND	25	7	D5
	24	6	D4
	23	5	D3
	22	4	D2
	21	3	D1
	20	2	D0
	19	1	STROBE
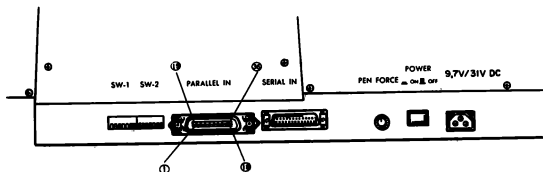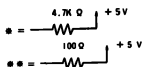
Fig. 8-1

(b) Input/Output signal lines
Input/Output signals of individual terminals are as follows.
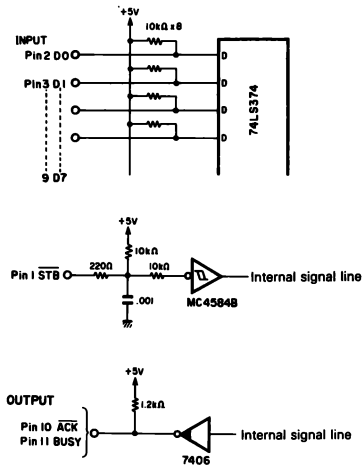
Fig. 8-2

(c) Input/Output signal timing chart

Input port latch

Read by CPU
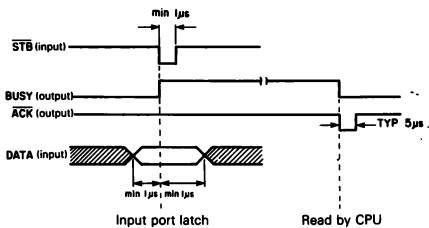
Fig. 8-3

8.1.2 Serial Connection

For serial (RS-232C) connection with various computers, refer to Chapter 4 "Connections."
For other computer or conditions refer to the following.

(a) Connector
Use a JAE DB-25PA-XX or its equivalent. The plotter is provided with a JAE DBLC-25AF or its equivalent.

Terminal No.	Signal	Pin connection
1	FG	
2	TXD	
3	RXD	
4	RTS	
5	CTS	
6	DSR	
7	SG	
8	DCD	
9	NC	
10	NC	
11	NC	
12	NC	
13	NC	
14	S.TXD	
15	NC	
16	S.RXD	
17	NC	
18	NC	
19	NC	
20	DTR	
21	NC	
22	NC	
23	NC	
24	NC	
25	NC	

Table 8-1

(b) Signal lines

Pin No.	Abbuev.	Description	I/O
1	FG	Security line which is normally connected with the computer frame. Connected to the plotter frame.	[Com]
2	TXD	Transmit data: Data output from the plotter to the computer. Connected to the receive data line of the computer. SPACE = "0" = +12V MARK = "1" = +12V	[Output]
3	RXD	Receive data: Data receive line of the plotter from the computer. Connected to the transmit data line of the computer. SPACE = "0" = +3V to +25V MARK = "1" = −3V to −25V	[Input]
4	RTS	Request to send. Output from the plotter to the computer. Always ON (+12V) is outputted.	[Output]
5	CTS	Clear to send: Input from the computer to the plotter. When the signal line is ON (+3V to +25V), the plotter is ready to output data, or when the line is OFF (−3V to −25V), no data will be output. When unconnected, the plotter operates with its always ON status.	[Input]
7	SG	Signal ground, connected with the internal ground line in the plotter.	[Com]
14	S.TXD	Normally, do not connect.	
16	S.RXD	Normally, do not connect.	
20	DTR	Data terminal ready: signal to indicate that the system is ready to communicate. As in RTS, with DIP SW-1-5 set to OFF (parallel). The plotter outputs OFF (−12V). When hardware handshake is enabled by the ESC @ command and remaining capacity of the buffer is 1/4. DTR is OFF (−12V). When remaining capacity is resumed to 1/2, DTR is ON (+12V). When hardware handshake is set to desable by the ESC @ command, DTR is always +12V. DTR can be connected with CTS, DSR or DCD of the bomputer for handshaking, provided that the computer should have a function to monitor the above signal line and stop the data output.	[Output]

table 8-2

8.2 Errors

When a parameter out of the specified range is input, DXY-990 determines that normal operation cannot be performed and display an error. While some errors allow the plotter to execute subsequent command inputs normal drawing will not be assured since the command at the time the error occurs is not executed.

8.2.1 Type of Error

When DXY-990 cannot perform its normal operation, the ERROR indicator will light to indicate an error. The cause can be one of the following:

① An undefined character is input as a command.
② Input procedure other than that specified.
③ Parameter is out of the specified range.
In the above cases, the OE command can be executed to discover the error contents. For details refer to the description of OE command.
Also, an error is indicated under either of the following conditions.
④ The protocol is not proper(When serial connection is used).
⑤ Proper device control command is not used.
In such a case, execute the ⌈ESC⌉. E command to discover the error contents. For details, refer to the description on the ⌈ESC⌉. E command.
This method can only be applied when the plotter is connected with the DXY-990 through its serial port (RS-232C).

8.2.2 Error Recovery

① Press the ☒ (lower left) key on the control panel.
② Execute the OE, IN command.
③ Basically, an error in command is recovered by means of the "OE" command, and the protocol is recovered by the ⌈ESC⌉. E command. Therefore, an error related to communication cannot be recovered by the "OE" or "IN" command.
If these methods cannot be used, turn the power switch of the DXY-990 OFF once and then turn it ON again to check.
Or, check the program or perform programming again from the beginning by pressing ☒ (lower left) key while pressing the ENTER key.

(Note 1)   There has to be a terminator (CHR[3] for character plotting commands and a semicolons for other commands) at the end of each command, otherwise the last command cannot be executed.

(Note 2)   An error occurs when the parameter, value of each command exceeds the following range concerning an absolute coordinate and a relative coordinate.

at absolute coordinate
commands

at relative coordinate
commands

The length (L1) from
current pen position
(A1) to the position de
signated by parameter
(B1) exceeds
32767.4999.

The position (B2)
specified relatively by
parameter exceeds a
range.
$-32768.0000 \sim +32$
767.4999 of world
coordinate from cur-
rent pen position (A2).
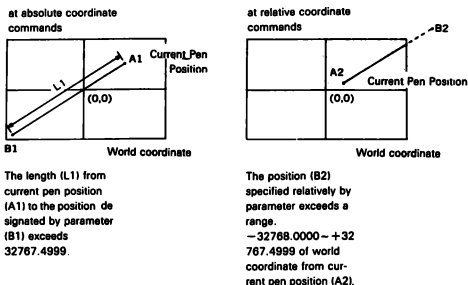
Fig. 8-4

8.2.3 Error by Distorted Positions

During drawing, if the pen carriage or the arm is touched by hands or other objects or,
if the pen in the pencarriage clashes with a pen in the penstock when the PEN SELECT
key is pressed while the ENTER key is pressed to store the pen, the position may
distort. If this happens, the error indicator may not go on and it will not become an error
but the coordinate system will be distorted.
To recover this, turn the power switch of the plotter OFF or reset the plotter by pressing
the LOWER LEFT key while pressing the ENTER key to start drawing from the beginn-
ing.

8.3 Mode Table

Mode	Function	To Set (To recover)
Self-Test Mode	The self-test mode is used to check the operation of the plotter before connecting to a computer. It is used when operating the plotter for the first time or to see if the plotter or the computer is causing a malfunction.	Turn the power swith ON while pressing ENTER Key. (After the self test run, the plotter will automatically enter the nomal mode.)
Monitor Mode(Y mode)	This is a special operating mode and is not normally used. In this mode, when the plotter is connected between the computer and the terminal by the serial (RS-232C) connection, all data will be ignored by the plotter and passed on until the plotter receives the ⌐ESC⌐ Y command.	Set the DIP switch 2-④ on the rear panel "ON" and turn the power switch ON. (Re-set the DIP switch (turn it OFF once) and turn the power switch ON again)
Digitizing Mode	Use the plotter as a Digitizer. In the Digitizing mode, DIGITIZE MODE indicator on the control panel goes on, and sets the condition where the computer can output the X and Y coordinate values and the pen status (up/down) set when the ENTER key is pressed. However, this can only be applied when the serial (RS-232C) connection is used and is not effective when the parallel (centronics) connection is used.	Transmit the DP command during programing (Press the ENTER key on the control panel or transmit the DC command)
Rotate Mode	Rotate the X•Y coordinate axis 90 degrees angle in the opposite direction. This mode can produce a 90 degrees rotated drawing.	Press the FAST key on the control panel while pressing the ENTER key. (Do the same operation once more or transmit the RO, the IN,or the DF command.)
Character Plotting Mode	Plot lines of characters using the currently assigned character set. This mode will not be recovered until it receives the level terminator defined by the DT command. Character variable numbers can also be used.	Transmit the LB command. (Transmit a label terminator)
Pen speed Adjust Mode	The pen speed can be changed manually. The pen speed set for each key is as follows: | Pen select key number	1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---	---
Pen seed (mm/sec)	30	40	60	90	120	160	220	300 | This method can be used by setting the plotter, regardless of computersoftware. Use this method if your software cannot change the program.	Press the PEN SELECT key (1)~(8) whil pressing PEN SPEED key. (Press the PEN SELECT key (8) while pressing the PEN SPEED key or, turn the power switch OFF and then turn it ON again.)

8.4 Dip Switch Setting Table

The DIP switches are set as shown above when the plotter is delivered from the factory.

SW—1		Paper size	Max. Plotting size
7	8		
OFF (A3)	OFF (ISO)	420×297mm	403×276mm
ON (A4)	OFF (ISO)	297×210mm	276×193mm
OFF (B)	ON (ANSI)	17×11inch	416×269mm
ON (A)	ON (ANSI)	11×8.5inch	269×199mm

ISO : International Standardization Organization.
ANSI : American National Standards Institute.
＊ISO · A3 and A4 are the same size as A3 and A4 of JIS (Japan Industrial Standard) respectively.

SW1-①~④
Select seven character sets out of the nineteen character sets of the DXY-990 for the initial font settings.
For details, refer to "5.5 Selection of Character Set" in Chapter 5 or "8.6 Character Code Table" in this chapter.

SW1-⑥
Set according to whether the connection with the computer is parallel (centronics) or serial (RS-232C).

SW1-⑦
Set the standard of the paper size according to ANSI or ISO.

SW1-⑧
Set the paper size according to B(A3) or A(A4).

SW2-①~⑧
Set the same as the computer side in term of baud rate, parity check, and other conditions when a serial (RS-232C) connection is applied.

8.5 Control Character Code Table

Decimal Value	Hex	ASCII Character	All Sets
0	00	NULL	Unused
1	01	SOH	Unused
2	02	STX	Unused
3	03	ETX	End Label Command
4	04	EOT	Unused
5	05	ENQ	RS-232C
6	06	ACK	RS-232C
7	07	BEL	Unused
8	08	BS	Backspace
9	09	HT	Half Back Left
10	0A	LF	Line Feed
11	0B	VT	Inverse Line Feed
12	0C	FF	Unused
13	0D	CR	Carriage Return
14	0E	SO	Select Alternate Character Set
15	0F	SI	Select Standard Character Set
16	10	DLE	Unused
17	11	DC1	Unused
18	12	DC2	Unused
19	13	DC3	Unused
20	14	DC4	Unused
21	15	NAK	Unused
22	16	SYN	Unused
23	17	ETB	Unused
24	18	CAN	Unused
25	19	EM	Unused
26	1A	SUB	Unused
27	1B	ESC	RS-232C
28	1C	FS	Unused
29	1D	GS	Unused
30	1E	RS	Unused
31	1F	US	Unused
32	20	SP	Space

8.6 Character Code Table

Hex	Deci mal	0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
21	33	!	!	!	!	!	!	À	•	!	!	!	!	!	!	!	!	!	!	!
22	34	"	"	"	"	"	"	Â	Γ	"	"	"	"	"	"	"	"	"	"	"
23	35	#	#	£	£	¿	#	È	⌐	#	#	#	#	£	£	£	£	#	§	
24	36	$	$	$	$	$	$	Ê	ヽ	¤	¤	¤	$	$	$	$	$	$	$	
25	37	%	%	%	%	%	%	Ë	°	%	%	%	%	%	%	%	%	%	%	
26	38	&	&	&	&	&	&	Î	ヲ	&	&	&	&	&	&	&	&	&	&	
27	39	'	'	⊡	'	⊡	'	Ì	ア	'	'	'	'	'	'	'	'	'	'	
28	40	(	(	(	(	(	(	´	ィ	(	(	(	(	(	(	(	(	(	(	
29	41	)	)	)	)	)	)	`	ゥ	)	)	)	)	)	)	)	)	)	)	
2A	42	*	*	*	*	*	*	^	エ	*	*	*	*	*	*	*	*	*	*	
2B	43	+	+	+	+	+	+	¨	ォ	+	+	+	+	+	+	+	+	+	+	
2C	44	,	,	,	,	,	,	~	ヤ	,	,	,	,	,	,	,	,	,	,	
2D	45	-	-	-	-	-	-	Ù	ュ	-	-	-	-	-	-	-	-	-	-	
2E	46	.	.	.	.	.	.	Û	ョ	.	.	.	.	.	.	.	.	.	.	
2F	47	/	/	/	/	/	/	£	ッ	/	/	/	/	/	/	/	/	/	/	
30	48	0	0	0	0	0	0	¯	-	0	0	0	0	0	0	0	0	0	0	
31	49	1	1	1	1	1	1		ア	1	1	1	1	1	1	1	1	1	1	
32	50	2	2	2	2	2	2		イ	2	2	2	2	2	2	2	2	2	2	
33	51	3	3	3	3	3	3	°	ウ	3	3	3	3	3	3	3	3	3	3	
34	52	4	4	4	4	4	4	Ç	エ	4	4	4	4	4	4	4	4	4	4	
35	53	5	5	5	5	5	5	ç	オ	5	5	5	5	5	5	5	5	5	5	
36	54	6	6	6	6	6	6	Ñ	カ	6	6	6	6	6	6	6	6	6	6	
37	55	7	7	7	7	7	7	ñ	キ	7	7	7	7	7	7	7	7	7	7	
38	56	8	8	8	8	8	8	¡	ク	8	8	8	8	8	8	8	8	8	8	
39	57	9	9	9	9	9	9	¿	ケ	9	9	9	9	9	9	9	9	9	9	
3A	58	:	:	:	:	:	:	¤	コ	:	:	:	:	:	:	:	:	:	:	
3B	59	;	;	;	;	;	;	£	サ	;	;	;	;	;	;	;	;	;	;	
3C	60	<	<	<	<	<	<	¥	シ	<	<	<	<	<	<	<	<	<	<	
3D	61	=	=	=	=	=	=	§	ス	=	=	=	=	=	=	=	=	=	=	
3E	62	>	>	>	>	>	>	ƒ	セ	>	>	>	>	>	>	>	>	>	>	
3F	63	?	?	?	?	?	?	¢	ソ	?	?	?	?	?	?	?	?	?	?	
40	64	@	@	@	@	@	@	â	９	@	@	É	@	§	à	@	§	§	@	

⊡ automatic backspace

Hex	Decimal	Font Set																		
		0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
41	65	A	A	A	A	A	A	ê	₮	A	A	A	A	A	A	A	A	A	A
42	66	B	B	B	B	B	B	ô	ツ	B	B	B	B	B	B	B	B	B	B
43	67	C	C	C	C	C	C	û	テ	C	C	C	C	C	C	C	C	C	C
44	68	D	D	D	D	D	D	á	ト	D	D	D	D	D	D	D	D	D	D
45	69	E	E	E	E	E	E	é	ナ	E	E	E	E	E	E	E	E	E	E
46	70	F	F	F	F	F	F	ó	ニ	F	F	F	F	F	F	F	F	F	F
47	71	G	G	G	G	G	G	ú	ヌ	G	G	G	G	G	G	G	G	G	G
48	72	H	H	H	H	H	H	à	ネ	H	H	H	H	H	H	H	H	H	H
49	73	I	I	I	I	I	I	è	ノ	I	I	I	I	I	I	I	I	I	I
4A	74	J	J	J	J	J	J	ò	ハ	J	J	J	J	J	J	J	J	J	J
4B	75	K	K	K	K	K	K	ù	ヒ	K	K	K	K	K	K	K	K	K	K
4C	76	L	L	L	L	L	L	ä	フ	L	L	L	L	L	L	L	L	L	L
4D	77	M	M	M	M	M	M	ë	ヘ	M	M	M	M	M	M	M	M	M	M
4E	78	N	N	N	N	N	N	ö	ホ	N	N	N	N	N	N	N	N	N	N
4F	79	O	O	O	O	O	O	ü	マ	O	O	O	O	O	O	O	O	O	O
50	80	P	P	P	P	P	P	Å	ミ	P	P	P	P	P	P	P	P	P	P
51	81	Q	Q	Q	Q	Q	Q	î	ム	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
52	82	R	R	R	R	R	R	Ø	メ	R	R	R	R	R	R	R	R	R	R
53	83	S	S	S	S	S	S	Æ	モ	S	S	S	S	S	S	S	S	S	S
54	84	T	T	T	T	T	T	å	ヤ	T	T	T	T	T	T	T	T	T	T
55	85	U	U	U	U	U	U	í	ユ	U	U	U	U	U	U	U	U	U	U
56	86	V	V	V	V	V	V	ø	ヨ	V	V	V	V	V	V	V	V	V	V
57	87	W	W	W	W	W	W	æ	ラ	W	W	W	W	W	W	W	W	W	W
58	88	X	X	X	X	X	X	Ä	リ	X	X	X	X	X	X	X	X	X	X
59	89	Y	Y	Y	Y	Y	Y	ì	ル	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5A	90	Z	Z	Z	Z	Z	Z	Ö	レ	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5B	91	[	[	[	Ø	[	[	Ü	ロ	[	Ä	Ä	Æ	Ä	°	[	°	¡	Ã	Æ
5C	92	\	√	Æ	¡	¥	É	\	Ö	Ö	Ø	Ö	ç	\	ç	Ñ	Ç	Ø
5D	93	]	].	]	ø	]	]	¿	ン	]	Å	Å	Å	Ü	§	]	é	¿	Õ	Å
5E	94	^	↑	⌧	æ	⌧	^	β	'	^	^	^	Ü	^	^	^	^	^	^
5F	95	_	▨▨▨▨	~	_	Ô	°	_	~	~	é	~	~	~	~	~	~
60	96		▨▨	`	`	_	Á			ù								

Hex	Deci mal	0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
61	97	a	a	a	a	a	a	Ã		a	a	a	a	a	a	a	a	a	a	a
62	98	b	b	b	b	b	b	ã		b	b	b	b	b	b	b	b	b	b	b
63	99	c	c	c	c	c	c	Đ		c	c	c	c	c	c	c	c	c	c	c
64	100	d	d	d	d	d	d	d		d	d	d	d	d	d	d	d	d	d	d
65	101	e	e	e	e	e	e	Í		e	e	e	e	e	e	e	e	e	e	e
66	102	f	f	f	f	f	f	Ì		f	f	f	f	f	f	f	f	f	f	f
67	103	g	g	g	g	g	g	Ó		g	g	g	g	g	g	g	g	g	g	g
68	104	h	h	h	h	h	h	Ò		h	h	h	h	h	h	h	h	h	h	h
69	105	i	i	i	i	i	i	Õ		i	i	i	i	i	i	i	i	i	i	i
6A	106	j	j	j	j	j	j	õ		j	j	j	j	j	j	j	j	j	j	j
6B	107	k	k	k	k	k	k	Š		k	k	k	k	k	k	k	k	k	k	k
6C	108	l	l	l	l	l	l	š		l	l	l	l	l	l	l	l	l	l	l
6D	109	m	m	m	m	m	m	Ú		m	m	m	m	m	m	m	m	m	m	m
6E	110	n	n	n	n	n	n	Ÿ		n	n	n	n	n	n	n	n	n	n	n
6F	111	o	o	o	o	o	o	ÿ		o	o	o	o	o	o	o	o	o	o	o
70	112	p	p	p	p	p	p	Þ		p	p	p	p	p	p	p	p	p	p	p
71	113	q	q	q	q	q	q	þ		q	q	q	q	q	q	q	q	q	q	q
72	114	r	r	r	r	r	r			r	r	r	r	r	r	r	r	r	r	r
73	115	s	s	s	s	s	s			s	s	s	s	s	s	s	s	s	s	s
74	116	t	t	t	t	t	t			t	t	t	t	t	t	t	t	t	t	t
75	117	u	u	u	u	u	u			u	u	u	u	u	u	u	u	u	u	u
76	118	v	v	v	v	v	v	−		v	v	v	v	v	v	v	v	v	v	v
77	119	w	w	w	w	w	w	¼		w	w	w	w	w	w	w	w	w	w	w
78	120	x	x	x	x	x	x	½		x	x	x	x	x	x	x	x	x	x	x
79	121	y	y	y	y	y	y	ª		y	y	y	y	y	y	y	y	y	y	y
7A	122	z	z	z	z	z	z	Ω		z	z	z	z	z	z	z	z	z	z	z
7B	123	{	π	[graphic]	[graphic]	[graphic]	{	«		{	ä	ä	æ	é	{	à	°	ã	æ	
7C	124	|	⊢	[graphic]	[graphic]	[graphic]	|	□		|	ö	ö	ø	ö	ù	|	ò	ñ	ç	ø
7D	125	}	→	[graphic]	[graphic]	[graphic]	}	»		}	å	å	å	ü	è	}	è	ç	õ	å
7E	126	~	[graphic]	[graphic]	[graphic]	~	~	±		–	–	ü	–	ß	¨	–	ì	~	°	|
7F	127		[graphic]	[graphic]	[graphic]															··

8.7 Command Table

	Command	Format	Parameter	Parameter range	Function	Page
AA	Arc Absolute	AAx,y,θc(,θd):	x : X coordinate of center y : Y coordinate of center θc : Center angle θd : Resolution	x,y=−32768.0000 to + 32767.4999 θc,θd=−32768.0000' to + 32767.4999' θd(5')	Draw Arc (abs)	6-1
AR	Arc Relative	ARΔx,Δy,θc (,θd):	Δx : Difference of X center coordinates Δy : Difference of Y center coordinates θc : Center angle θd : Resolution	Δx,Δy=−32768.0000 to + 32767.4999 θc,θd=−32768.0000' to + 32767.4999' θd(5')	Draw Arc (rel)	6-2
CA	Alternate Character Set	CA: CAn:	n : Character set number	n=0 to 4,6 to 9,30 to 39(0)	Designate Alternate Character Set.	6-3
CI	Circle	CIr(,θd):	r : Radius θd : Resolution	r=−32768.0000 to +32767.4999 θd=−32768.0000' to 32767.4999'(5')	Draw Circle with Current Position as center	6-4
CP	Character Plot	CP: CPnx,ny:	nx : number of characters in X direction ny : number of characters in Y direction	−128.0000 to +127.9999	Move Determind Number of character Spaces	6-5
CS	Standard Character Set	CS: CSn:	n : character set number	n : 0 to 4,6 to 9,30 to 39(0)	Designate Standard Character Set	6-7
DC	Digitize Clear	DC:	None	None	Exit from Digitize Mode	6-8
DF	Default	DF:	None	None	Default	6-9
DI	Absolute direction	DI: DIrun,rise:	run=0 : vertical printing rise=0 : horizontal printing	−128.0000 to +127.9999 (run=1,rise=0)	Determine Character Rotation Angle (abs.)	6-10
DP	Digitize Point	DP:	None	None	Enter Digitize Mode	6-11
DR	Relative Direction	DR: DRrun,rise:	run=0 : vertical printing rise=0 : horizontal printing	−128.0000 to +127.9999 (run=1,rise=0)	Determine Character Rotation Angle (rel.)	6-12
DT	Define Terminator	DTc:	c : character	Other than null character (CHR$(3))	Define Label Terminal	6-13
EA	Edge Rectangle Absolute	EAx,y:	x : X coordinate of corner y : Y coordinate of corner	−32768.0000 to +32767.4999	Draw Quadrangle (abs.)	6-14
ER	Edge Rectangle Relative	ERΔx,Δy:	Δx : Difference X coordinate of corner Δy : Difference Y coordinate of corner	−32768.0000 to +32767.4999	Draw Quadrangle (rel.)	6-15
EW	Edge Wedge	EWr,θ₁,θc(,θd):	r : Radius θ₁ : Start angle θc : Center angle θd : Resolution	r=−32768.0000 to +32767.4999 θ₁,θc,θd=−32768.0000' to ,+32767.4999° θd(5')	Draw Wedge	6-16
FT	Fill Type	FTn(,d(,θ)):	n=1,2 : Fill in both direction n=3 : Hatching n=4 : Cross hatching d : Hatching spacing θ : Hatching angle	n=1 to 5 (1) d=0 to 32767.4999 ((P2-P1)×0.01) θ=−360° to +360° (0)	Designate Hatching Type	6-17
IM	Input Mask	IM: IME:	E : Error Mask		Input Mask	6-18
IN	Initialize	IN:	None	None	Initialize	6-19
IP	Input P1 & P2	IPP1x,P1y (,P2x,P2y):	X and Y coordinates of P1 and P2	None	Input P1 & P2	6-20
IW	Input Window	IWx₁,y₁,x₂,y₂:	x₁,y₁ are coordinates of the lower left corner of the drawing area x₂,y₂ are coordinates of the upper right corner		Input Plotting Area	6-21

Command		Format	Parameter	Parameter range	Function	Page
LB	Label	LBc₁c₂...cₙ CHR$(3)	c : character string		Draw Character (A)	6-22
LT	Line Type	LT : LTn (,p) ;	n : pattern No p : pitch (%)	n = −128 to +127(Solid Line) p = 0 to 127.9999(4)	Designate Line Type . Determine Pitch	6-23
OA	Output Actual Position	OA :	None	None	Output Current Position (ptr.)	6-24
OC	Output Commanded Position	OC :	None	None	Output Current Position (usr.)	6-25
OD	Output Digitize	OD :	None	None	Output Last Digitized coordinaters	6-26
OE	Output Error	OE :	None	None	Output Error Code	6-27
OF	Output Factors	OF :	None	None	Output plotter unit number 1mm	6-28
OH	Output Hard. Clip Limits	OH :	None	None	Output coordinate values of Hard clip	6-28
OI	Output Identification	OI :	None	None	Output model name of plotter (DXY-990)	6-29
OO	Output Options	OO :	None	None	Output option parameter	6-29
OP	Output P1 & P2	OP :	None	None	Output P1 & P2	6-30
OS	Output Status	OS :	None	None	Output Status Byte	6-30
OW	Output Window	OW :	None	None	Output Coordinates of lower left corner and upper right corner of window	6-32
PA	Plot Absolute	PA : PAx₁,y₁,xₙ,yₙ ;	Absolute X and Y coordinates	−32768.0000 to +32767.4999	Designate Absolute Mode, Move	6-32
PD	Pen Down	PD : PDx₁,y₁,xₙ,yₙ ;	X and Y coordinates	−32768.0000 to +32767.4999	Pen Down	6-34
PR	Plot Relative	PR PRΔx₁,Δy₁,Δxₙ, Δyₙ ;	Relative X and Y coordinates	−32768.0000 to +32767.4999	Designate Relative Mode, Move	6-35
PS	Paper Size	PSs :	s : paper size	0 to 127		6-36
PT	Pen Thickness	PT : PTd :	d : Pen Thickness (mm)	0.1 to 5.0(0.3)	Determine Filling Spacing	6-36
PU	Pen Up	PU : PUx₁,y₁,xₙ,yₙ :	X and Y coordinates	−32768.0000 to +32767.4999	Pen UP	6-34
RA	Shade Rectangle Absolute	RAx,y :	x : X coordinate of corner y : Y coordinate of corner	−32768.0000 to +32767.4999	Fill Quadrangle (abs.) with absolute coordinates	6-37
RO	Rotate Coordinate System	RO : ROn :	n : degree	0° or 90°		6-38
RR	Shade Rectangle Relative	RRΔx,Δy :	Δx : X coordinate of corner Δy : Y coordinate of corner	−32768.0000 to +32767.9999	Fill Quadarangle (rel.) with rerative coordinates	6-40
SA	Select Alternate Set	SA :	None	None	Use Alternative Character Set	6-41
SC	Scale	SCxmin,xmax, ymin,ymax :	xmin,ymin : coordinates of P1 xmax,ymax : coordinates of P2	−32768.0000 to +32767.9999	Set User Coordinaters	6-41
SI	Absolute Character size	SI : SIw,h :	w : character width (cm) h : character height (cm)	−128.0000 to +127.9999 (A3/B size : w = 0.29 h = 0.38 A4/A size : w = 0.19 h = 0.27)	Determine Absolute character size	6-42

	Command	Format	Parameter	Parameter range	Function	Page
SL	Character Slant	SL : SLtanθ :	tanθ : character slant	-128.0000 to $+127.9999(0)$	Determine Character Slant	6-43
SM	Symbol Mode	SM : SMk :	k : character or symbol	ASCII 33~126 excluding 59	Draw Designated Character at Current Position	6-44
SP	Pen Select	SPn :	n : pen number	n=0 to 8(0)	Change Pen	6-45
SR	Relative Character size	SR : SRw,h :	w : character width (%) h : character height (%)	-128.0000 to $+127.9999$ (w=0.75,h=1.5)	Determine Relative Character Size	6-46
SS	Select Standard Set	SS :	None	None	Use Standard Character Set	6-46
TL	Tick Length	TL : TLtp(,tn) :	tp : Tick length for positive direction (%) tn : Tick length for negative direction (%)	-128.0000 to $+127.9999(0.5)$	Determine Tick Length	6-47
UC	User Defined Character	UC : UCΔX$_1$,ΔY$_1$,ΔX$_n$, ΔY$_n$:	ΔX$_n$: number of X grids ΔY$_n$: number of Y grids	-128.0000 to $+127.9999$	Draw User-Defined Character	6-48
VS	Velocity Select	VSs :	s : pen speed (cm/sec)	0 to 127.9999(30)	Determine Pen Speed	6-50
WG	Shade Wedge	WGr,θ_1,θc(,θd):	r : Radius θ_1 : Stat angle θc : Center angle θd : Resolution	r= -32768.0000 to $+32767.4999$	Fill Wedge	6-50
XT	X-Tick	XT :	None	None	Determine Draw Tick on X Axis	6-52
YT	Y-Tick	YT :	None	None	Determine & Draw Tick on Y Axis	6-52

8.8 Specifications

Hardware specifications

Plotting area:	X axis : 416mm, Y axis : 276mm
Plotting speed:	300mm/sec.
Hardware resolution:	0.05mm/step
Software resolution:	0.025mm/step
Paper size:	Maximum 420mm×297mm (ISO•A3) or 432mm×279mm (ANSI-B)
Paper setting:	Electrostatic paper holder
Distance accuracy:	±0.3mm or ±0.1mm, whichever is larger
Repeatabibty:	With same pen ±0.1mm or less
	With different pen ±0.3mm or less
Control switches:	PEN SELECT,PEN SPEED, DISPLAY RESET, P1, P2, LL, UR, ENTER, POSITION(8 directions), PEN UP/DOWN, PAUSE, PAPER HOLD, POWER
DIP switches:	FONT, MODE, BAUD RATE, MODE
Display LED,s:	X-Y COORDINATES, ERROR, DIGITIZE MODE, PAUSE, PAPER HOLD
Data buffer:	1K byte
Interfaces:	Parallel (Centronics)
	:Serial (RS-232C)
Number of pens:	8 (black, red, blue, green, purple, brown, orange, pink)
Power supply:	Original AC adapter (DC9.7V, 31V)
Power consumption:	35VA
Operating temperature:	5℃~40℃
Operating humidity:	20%~80% (no dew forming)
Dimensions:	608(W)×115(H)×452(D)mm (23-7/8"×4-5/8"×17-3/4")
Weight:	6.5kg(main unit only).
Accessories:	8 original water-based fiber-tipped pens (XD-4SPB-WN, XD-4SPC-WN), marking seals, rubber seals, an original AC adapter, a dust cover.

Interface specifications
[Parallel]

Standard:	Centronics
Input signals:	STROBE (1 bit), DATA (8 bit)
Output signals:	BUST (1 bit), ACK (1 bit)
Input/Output signal level:	TTL level
Transfer system:	asynchronous

[Serial]

Standard:	RS-232C
Transfer system:	asynchronous , full-duplex data communication
Transfer speed:	150, 300, 600, 1200, 2400, 4800, 9600.(selected by DIP switch)
Stop bit:	1 or 2 bits(selected by DIP switch)
Parity check:	Odd, Even, None (selected by DIP switch)
Connector:	DB-25S

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